

Author Index

	PAGE		PAGE
ADIYODI, K. G.	587	Bhatnagar, M. K.	370, 417
Agarwal, I. P.	443	Bhatnagar, S. O. D.	489
Agarwal, V. C.	624	Bhatt, Y. M.	512
Agate, A. D.	503	Bhrara, S. C.	486
Agnihothrudu, V.	76, 131, 239	Bhutani, S. P.	363
Agrawal, D. P.	4, 114, 276, 585	Biradar, N. S.	37, 385
Agrawal, V. D.	539	Bopardikar, B. P.	364
Ahmad, S. I.	229	Boraiah, G.	314
Akhtar Husain	394	Bose, A. R.	336
Alexander, K. C.	603	Bose, M. N.	569
Amarjit Singh	355	Brahmaji Rao, S.	202
Amar Singh	22	Buta Singh	240
Amir Singh	77		
Anand, S.	540	CHACKO, K. K.	529
Anantharaman, T. R.	583	Chacko, P. M.	630
Anima Devi	13, 463	Chalapathi Rao, V.	492
Appa Rao, K. V. S. R.	299	Chanda, M.	488
Appaswamy Rao, M.	433	Chand, J. N.	240
Atal, C. K.	546	Chandrasekharan, G. (Mrs.)	529
Attewall, P. B.	491	Chandrasekharan, R.	592
Azam, F.	522	Chandrasekhara Rao, G.	129, 212
		Chatterji, U. N.	574
BABU RAO, K.	616	Chaudhuri, S. B.	187
Badarinarayana, M. C.	169	Chenulu, V. V.	183
Bagyaraj, J.	94, 238	Chetal, A. R.	563
Bahadur, K.	391	Chhatriwalla, K. M.	123
Bahl, C. P.	281	Chibber, S. S.	363
Bakshi, J. S.	355	Chiplonkar, V. T.	582
Banerji, D.	601	Chitaley, S. D.	444
Banerji, D. K.	575, 597	Chopra, V. L.	91
Banerji, M. L.	105	Chowdhary, S. Y.	230
Banerji, R.	152	Chowdhury, A. R.	543
Banerji, S. N.	597		
Banerji, T. K.	596	DAFTARI, L. N.	416
Basak, S. L.	631	Dana, S.	629
Baxi, D. (Miss)	574	Das, A. K.	178
Belsare, D. K.	480	Das, D. P.	595
Bhakuni, D. S.	313	Das, P. K.	445
Bhambie, S.	46	Das, S.	105
Bhargava, S. N.	396	Das, U. K.	312
Bhatia, B. B.	103	Das, V. S. R.	20, 50, 160, 288, 471
Bhatia, S. K.	213	Dasgupta, J.	290
Bhat, J. V.	58, 237, 503	Dasgupta, P. R.	336
Bhatnagar, G. C.	371	Dash, B. C.	595
Bhatnagar, K. P.	97		

	PAGE		PAGE
Dash, K. C.	63, 203, 462	HANUMANTHA RAO, K. ..	70, 626
Datta, N.	75	Haranadh, C.	229
Datta, S. C.	252	Haranath, P. B. V. ..	616
Dave, Y. S.	559	Hariharan, V.	390
David, H.	575	Harish Chandra	365
Dawson, M. J.	612	Haug, E.	566
Dayal, R.	208, 209	Hazarika, J. N.	187
Dekate, Y. G.	339	Hegde, K. T. M.	623
Deodikar, G. B.	186	Hema, P.	624
Deoras, P. J.	415	Henry, A. N.	106
Desai, Y. R.	582	Honwar, V. K.	333
Deshpande, D. K.	360		
Deshpande, S. M.	335	IBRAHIM, S. H.	169
Dhanraj, K. S.	446	Indira Chary, C. A. (Miss) ..	350
Dhar, R. D.	132	Iqbaluddin	44
Dighe, V. S.	594	Irudayasamy, A.	215
Dorie, A. K.	480	Iswaran, V.	126
Dutta, S.	338		
Dutta, S. K.	440, 519	JAGMOHAN RAI	146
Dutt, M. K.	497	Jain, A. C.	35, 323
Dutt, S.	329	Jain, B. D.	173, 516, 557, 593
		Jain, B. L.	352
EASTERSON, D. C. V.	622	Jain, R. K.	208, 443
Elayidom, N. B.	265, 357	Jain, S. P.	317
Endrizzi, J. E.	34	Jain, S. S.	610
		Janaki Ammal, E. K.	132
FATHIMA, T.	73	Janardhanan, K. K.	394
		Jayaraj, S.	572
GANAPATI, P. N.	129, 212	Jayaraman, R.	378
Gandhi, R. N.	121, 464, 514	Jayasankar, N. P.	503
Ganesan, R.	408	Jnanananda, S.	384, 435
Gangadhara Rao, L. V.	378	Johari, R. P.	125
Ganla, V. G.	542	Jose Jacob, T.	334
Garg, O. P.	155	Joshi, G.	512
George, K.	444	Joshi, L. M.	523
George, M. G.	67	Joshi, P. V.	236
Ghani, N.	211	Joshi, R. V.	344
Ghosh, A.	596	Joshi, S. A.	42
Ghosh, R.	22		
Ghosh, S. S.	118, 233, 488	KAILASAM, L. N.	197
Ghumman, B. S.	540	Kalani, I. K. (Miss)	416
Gill, H. S.	292	Kalra, A. N.	545
Goel, D. P.	594	Kalra, V. K.	204
Gopal, V.	550	Kalyanaraman, A. R. ..	529
Gopalakrishna, C. V. S. S. V. ..	229	Kamat, N. D.	179
Gopal Narain	176, 202, 282, 307, 462	Kamboj, V. P.	543
Govil, G.	564	Kameswara Rao, K.	591
Govinda Rajulu, B. V.	96	Kanekar, C. R.	37, 93, 361, 459
Govindu, H. C.	393	Kantimati, B.	359
Gracy Basile (Mrs.)	290	Kapur, K. K.	546
Gupta, P. D.	624	Kar, A. B.	336, 365, 543
Gupta, R.	152	Kar, K.	308
Gupta, R. C.	539	Katyal, M.	388
Gupta, U. S.	311	Kaul, B. L.	382
Gupta, V. C.	95, 128	Kaul, C. L.	289
		Kaul, D. K.	521

	PAGE		PAGE
Kazi, A. M. Z.	255	Mahapatra, G. N.	595
Kere, S. S.	509	Maheshwari, J. K.	181
Kesavan, P. C.	403	Maithy, P. K.	412
Khambata, S. J.	362	Malapa, M. M.	239
Khanna, M. L.	143, 494	Malhotra, A.	437
Khanna, R. K.	311	Malik, B. S.	16
Khare, M. P.	489	Malik, K. K.	388
Kharkwal, A. D.	441	Mallikarjunan, M.	529
Khatri, H. L.	183	Mande, C.	563
Khetrapal, C. L.	459, 564	Mandwal, N. K.	621
Khoshoo, T. N.	614	Mani, R. S.	16, 230, 305, 401, 590
Kishan Singh	602	Manna, G. B.	482
Kishore, H.	213	Manohar, H.	377
Knypl, J. S.	157	Maqbool Begum	262
Koshy, B. C.	439	Marathe, K. B.	538
Kothari, K. L.	370, 417	Marathe, V. R.	385
Krishna Mohan Rao, P. S.	201	Marigangiah	517
Krishnamoorthi, B.	72	Mathew, M. P. (Miss)	562
Krishnamoorthy, V.	40, 609	Mathur, B. L.	447
Krishnamurti, M.	167	Mathur, J. M. S.	302
Krishnamurthy, S. S.	389	Mathur, M.	156
Krishnan, S. K.	64	Mathur, S. L.	263
Krishna Rao, J.	589	Meenakshi, G.	406
Krishna Rao, J. S. R.	257	Mehra, A. L.	304
Krishna Rao, K. V.	280	Mehrotra, N. K.	120, 304, 485
Krishna Reddy, Y.	64	Mehta, R. K.	22, 125
Krishna Sastry, K. S.	612	Menon, C. B.	413
Krishnaswamy, N. R.	11, 542	Menon, R. G.	422
Krishnaswamy, S.	45, 72	Merchant, J. R.	123, 255, 281
Kukla, A. S.	204	Miller, D. M.	225
Kulkarni, A. B.	206	Miranda, M. D.	362
Kuloor, N. R.	169	Mishra, D.	340
Kumari, D.	223, 387, 477	Mital, K. R.	312
Kumar, R.	286	Mohan Ram, H. Y.	48
Kumar, S.	546	Mohanty, S. K.	340
Kuriacose, J. C.	306	Mohinder Pal	614
Kuriyan, J.	550	Mukerjee, A. K.	335
Kusumgar, S.	4, 276, 585	Mukherjee, S. L.	594
		Mukherji, K. (Mrs.)	178
LAKHANPAL, R. N.	209	Mukerji, S. K.	223, 387, 445, 477
Lakshman, S. V. J.	15	Mullakhanbhai, M. F.	58, 237
Lal, B. M.	125	Multani, R. K.	516, 593
Lalitha, V. R.	410	Mungurwadi, B. D.	405
Lal, K. C.	15	Munshi, A. A.	283
Laloraya, M. M.	601	Murthy Reddy, K. B. S.	130
Laundon, G. F.	492	Murti, V. V. S.	64, 252, 437
Leela Iyengar (Miss)	280	Murty, C. R. K.	229, 252, 591
Leelavathy, K. M.	470	Murty, K. S.	548
Lele, K. M.	412	Mustafee, T. P.	370
Lele, V. C.	446		
Likhite, S. D.	534	NAGABHUSHANAM, R.	467
Lucy Channamma, K. A.	287	Naganna, C.	127
		Nagarajan, G. R.	409
MAADAN, C. L.	311	Nagarajan, S.	176
Madhavi, R.	70	Nagaraj, M.	19, 497
Madhadevappa, D. S.	517	Nagender Naidu, S. V.	280

	PAGE		PAGE
Nageswara Rao, M.	518	Prakash, S.	303
Nageswara, S.	235	Prasada Rao, G. S. R. C. V. ..	303
Nair, A. G. R.	176	Prasada Rao, T. S. R.	303
Nair, K. P. R.	593	Prasad, C. B.	16
Nair, N. G. K.	442	Prasad, C. R.	303
Naithani, S. P.	343	Prasad, N.	303
Nandgaonkar, R. R.	285	Prasad, T. P.	303
Narain, A.	493	Prasad, T. P.	303
Narasimham, N. A.	331, 485	Pratap Singh	303
Narasimhachari, N.	66	Prema Swarup, D.	303
Narasimhan, M. J. (Jr.)	542	Pujar, M. A.	303
Narasimha Rao, B. V.	384		
Narasinga Rao, Ch.	490	QASIM, S. Z.	140
Narayana, L. L.	74		
Narayana, K. L.	38	RACHIE, K. O.	303
Narayanan, K.	566	Radhakrishnamurty, C.	303
Narayana, R.	130	Radhakrishna Murty, P.	12, 461
Narula, P. N.	547	Radhakrishna Setty, D. L.	403
Natarajan, A. R.	215	Radha Pant	42
Nataraja Sarma, P. S.	43	Raghaviah, P.	303
Nayar, K. K.	587	Raghunath, T.	413
Nigam, H. L.	63	Raghurama Rao, M.	158, 367
Nipankar, S. V.	361	Raina, P. L.	13
Nithyanandan, V. V.	43	Rai, J.	478
	23	Rai, P.	102
OPPENHEIMER, C.	23	Rajagopalan, T. R.	121, 460, 504
PADMAJA SHUKLA (Miss)	282	Raja Rao, C. S.	44
Padmanabhan, D.	104	Raja Rao, M.	433
Padmanabhan, S. Y.	610	Rajaram, J.	306
Pakrashi, S. C.	468	Raja Reddy, G.	177
Pakrasi, K.	549	Rajendran, V.	472
Pal, A.	338	Rajendra Prasad	317
Pande, B. P.	102, 103	Raj Kumar	173, 307
Pande, I. C.	519	Raju, P. V.	30
Panduranga Rao, V.	177	Ramaiah, M.	41
Panikkar, N. K.	451	Ramachandra Ayyar, R.	329
Parrack, D. W.	544	Ramachandran Nair, C. G.	304
Parthasarathy, M. R.	281	Ramachandra Rao	303
Patel, R. J.	631	Ramachandra Rao, C. V. S.	331
Patel, R. M.	261	Ramachandra Rao, L.	146, 447
Patel, R. N.	408, 618	Ramachandra Rao, V.	12, 461
Pathak, R. C.	312	Ramadevi, P.	626
Patnaik, B. K.	595	Ramakoteswara Rao, P.	299
Patwardhan, W. D.	42, 391	Ramakrishnan, S.	124, 176, 304
Paulpandian, AL.	45, 178	Ramalingam, K.	101
Pavri, K. M.	455	Ramalingam, S. K.	233, 368
Periasamy, K.	427	Ramamoorthy, S.	145
Pillai, C. N.	566	Ramamurthy, V. D.	100
Pillai, S. C.	247	Raman, Sir C. V.	1, 29, 30, 43,
Ponnappa, K. M.	492		111, 137, 165, 193, 221,
Poulose, K. V.	183		245, 271, 297
Powar, K. B.	519	Ramana Rao, D. V.	63, 203, 408, 462, 618
Prabakaran, R. J. V.	16	Ramana, Y. V.	491
Prabhakar, V. S.	604	Ramanujam, C. G. K.	158, 257, 367, 576
Prakasa Sastry, C. S.	146	Rama Rao, K. V. S.	252
		Ramaseshan, S.	87

	PAGE		PAGE
Ramaswami, B. S. ..	66	Sarma, B. V. S. ..	177
Ramaswami, L. S. ..	521	Sarma, K. G. ..	147
Rana, R. S. ..	414	Sarma, N. K. ..	439
Ranganathan, S. ..	6	Saroja, T. ..	477
Ranga Rao, V. ..	487	Sastri, M. N. ..	308, 516
Rangaswami, G. ..	238, 598	Sastri, M. N. ..	617
Rangaswami, S. ..	205, 364, 390, 515, 564, 618	Sastry, G. R. K. ..	91
Rangaswami, M. ..	332	Sastry, M. S. ..	545
Rao, A. N. ..	380	Sastry, P. S. ..	41
Rao, A. S. ..	333	Sastry, T. P. ..	41
Rao, G. R. ..	524	Satyanarayana Murty, A. ..	366
Rao, J. V. S. ..	160, 288, 471	Satyanarayana Murthy, K. ..	616
Rao, K. N. ..	160, 288	Satyanarayana Rao, T. S. ..	492
Rao, K. V. M. ..	471	Saxena, M. C. ..	120, 229, 304, 485
Rao, M. P. ..	20, 50	Saxena, M. N. ..	256
Rao, P. S. ..	147, 384	Sehgal, S. P. ..	416
Rao, R. P. ..	541	Sen, S. P. ..	317
Rao, Y. P. ..	60	Seshadri, A. R. ..	572
Ratnam, C. V. S. ..	439	Seshadri, K. V. ..	408
Ravi Kumar, P. R. ..	235	Seshadri, R. ..	100
Reddy, K. N. ..	545	Seshadri, T. R. ..	11, 35, 40, 64, 121, 147, 167, 204, 223, 252, 281, 323, 363, 387, 409, 431, 460, 477, 486, 542, 514, 609
Rehna Majid (Mrs.) ..	420	Seshagiri, V. ..	202
Rekib, A. ..	337	Seshagiri Rao, D. ..	214
Rode, V. P. ..	411	Seth, B. R. ..	581
Rohatgi, V. K. ..	35	Sethuram, B. ..	254
Rout, G. ..	577	Setty, T. H. V. ..	235
Royan-Subramaniam, S. ..	406	Shah, J. J. ..	183, 559
Roy, R. P. ..	420	Shah, K. B. ..	359
Roychowdhury, T. ..	549	Shanmugasundaram, Radha ..	336
SABESAN, M. N. ..	529	Shanmugasundaram, E. R. B. ..	336
Sadasivan, T. S. ..	273	Sharda, R. T. ..	213
Sadhu, D. P. ..	337	Shariff, A. ..	96
Sadique, J. ..	336	Sharma, B. R. ..	11, 542
Sah, S. C. D. ..	69	Sharma, D. S. ..	411
Sahai, B. N. ..	628	Sharma, H. C. ..	150
Sahay, G. ..	261	Sharma, N. C. ..	207
Sahai, B. G. ..	368	Sharma, P. C. ..	444
Sahni, M. R. ..	128, 286	Sharma, R. P. ..	21
Saini, A. D. ..	600	Sharma, V. K. ..	185
Saini, G. R. ..	259	Sharma, V. N. ..	290, 313
Salagar, S. S. ..	123, 281	Shashidhar, M. A. ..	62, 230, 513, 616
Sali, S. A. ..	344	Sheela, R. ..	74
Sampath, S. ..	278	Sheik, B. H. ..	455
Sanderson, G. W. ..	392	Sheila Gopal (Kum.) ..	485
Sankara Subramanian, S. ..	124, 176, 284, 437	Sheriff, A. ..	19
Sankara Rao, C. ..	457	Sheriff, E. M. ..	433
Sankhla, N. ..	574	Shinde, V. A. ..	443
Santappa, M. ..	145, 332, 437	Shipra Dutta ..	48
Santhakumary, N. ..	310	Shivanandappa, N. ..	393
Saraswathy Royan, S. ..	265	Shivappa Setty, K. ..	287
Sarbhoy, A. K. ..	396	Shome, S. K. ..	370
Sarin, Y. K. ..	604	Shri Prakash ..	175
Sarkar, M. K. ..	233	Shrivastava, A. K. ..	97
Sarkar, S. S. ..	341		

	PAGE		PAGE
Shroff, D.	206	Subba Rao, V.	518
Shukla, J. P.	120	Subrahmanyam, N.	118
Shukla, R. C.	151	Subrahmanyam, R.	482
Shukla, R. T.	338	Subramanian, C. V.	352
Shukla, U. S.	602	Subramanian, G. B. V.	431
Shibal, D. N.	439	Subramaniam, M. K.	265, 357, 406
Singh, A. P.	522	Subramanian, E.	529
Singh, D. N.	522	Subramanian, S. A.	309
Singh, F.	48	Subramanian, S. V.	437
Singh, H.	431	Subramanyam, M. D.	278
Singh, J. P.	292	Subramanyam, S.	377, 406
Singh, K. K.	442	Subramoni Iyer, V.	364, 618
Singh, N. L.	62, 360	Sudha Kale	180
Singh, P.	515	Sundara Rajulu, G.	393
Singh, R.	153	Sundara Ramaiah, T.	457
Singh, R. B.	484	Sundara Rao, W. V. B.	126
Singh, R. D.	386	Sundar, D. S.	308
Singh, R. P.	122, 175, 388, 594	Sur, B. K.	207
Singh, R. S.	386	Surendra Kumar	441
Singh, S.	547	Suresh Chandra	511
Singh, S. P.	628	Suryanarayana Murthy, P.	146
Singh, S. D.	132 583	Suryanarayana Rao K.	62, 230, 360, 513, 616
Singh, S. N.	62, 360	Swaminathan, M. S.	91, 403, 469
Singh, S. P.	289	Swamy, B. G. L.	427
Singh, V.	250	Swamy, C. S.	253, 567
Sinha, H. B.	628		
Sinha, S. C.	63	TANDON, R. N.	419
Sirsi, M.	94, 438	Tandon, S. L.	156, 524
Sisodia, K. P.	343	Tewari, R. N.	292
Somasekhara, S.	594	Thakar, B. B.	592
Sood, B. S.	540	Thackar, C. V.	186
Somasekar, B.	127	Thakar, K. A.	148
Soundararajan, S.	233, 389, 568	Thakar, G. K.	496
Srihari Rao, K.	15	Thakar, N. V.	93
Srikrishnan, T.	529	Thakar, V.	496
Srimannarayana, G.	410	Thirugnanam, M.	598
Srinath, E. G.	247	Thivy, F.	150
Srinivasan, K. V.	603	Thyagaraja Rao, S.	529
Srinivasan, R.	529	Tikader, B. K.	520, 627
Srinivasan, V. R.	487	Tiwari, G. D.	569
Srinivasan, V. V.	71	Trikha, K. C.	175, 594
Srinivasulu, K.	490	Trivedy, A. N.	68
Srivastava, A. K.	154	Trivedi, J. P.	283
Srivastava, D. N.	60	Trivedi, R. N.	420
Srivastava, H. N.	15	Trivedi, S. R.	569
Srivastava, J. P.	621	Turkhede, B. B.	312
Srivastava, M. L.	624		
Srivastava, M. P.	419	UNNIKRISHNAN, K.	183
Srivastava, N. K.	209	Unni Krishnan, M.	4, 276
Srivastava, P. S. L.	547	Upadhya, K. N.	484, 593
Srivastava, S. C.	42, 422	Usgaonkar, R. N.	620
Srivastava, S. N.	290, 313		
Srivastava, S. N. S.	327, 506	VAIDYA, B. S.	600
Subba Rao, A. V.	149	Vakula Radha, T.	487
Subba Rao, N. S.	126	Vasudevan Nambudiri, E. M.	421
Subba Rao, N. V.	149, 410	Veeraiah, T.	589
		Venkata Chalapathi, V.	301, 350

	PAGE		PAGE
Venkata Ramiah, K. ..	301, 350	Verughese, G.	469
Venkatarangan, P. ..	139	Vimal Mehdi,	77
Venkata Rao, E. ..	518	Vyas, D. K.	570
Venkatasubramanian, N. ..	171		
Venkatesan, K. ..	529	WILLIAMSON, D.	396
Venkateswara, Rao, P. ..	616	Wisniewska, J. M.	157
Venkateswarlu, K. ..	562		
Venugopalan, V. K. ..	99	YADAVA, R. L.	18
Verghese, J. ..	235	Yag Dutt	122
Verghese, T. M. ..	317		
Verma, M. R. ..	478	ZENKTELER, M.	18
Verma, P. K. ..	145	Zutshi, U.	439

Subject Index

	PAGE		PAGE
ABNORMAL Genital System in the Leech <i>Hirudinaria granulosa</i>	97	Amino-Acids of <i>Dermatocarpon moulinsii</i>	284
Absorption Spectra and Configuration of Amine Complexes of Copper (II) Chromate Dihydrate	282	— — <i>Lobaria subisidiosa</i> and three other lichens	124
— — of Inorganic Co-ordination Complexes	202	Amino Complexes of Cobalt (II) Phthalimide	462
Acetylene Hydropolymerization Reaction, Effect of $\text{ZnO-Cr}_2\text{O}_3$ Additive in palladium catalyst	488	Analysis of Phenol, Hydroquinone, Quinone and Maleic Anhydride in a Mixture	169
Activity Cycle of the Lesser Bandi- coot Rat	544	— — Spectrophotometric Data	93
Adaptation of Vision to Dim Light ..	165	Analytical Technique as Powerful as the Infrared	555
Adducts of Lanthanon Chlorides with Dimethyl Sulphoxide	233	Animal Fossil and Early Stone Age Tools from Gangapur on the Godavari River, Nasik	344
Alcoholates of Ferrous Chloride ..	516	Anion-Cation Collision Diameters of Molten Salts	589
Alkaline Hydrogen Peroxide, Action of, on α -Methoxy Chalkones	35	Announcements .. 219, 400, 450, 527	
— Phosphatase and Glycogen in the Intestine of Freshwater Teleosts ..	154	Anomalous Scattering of Neutrons, Use of, in the Solution of Crystal Structures Containing Large Mole- cules	87
Alkaloidal Constituents of <i>Crotalaria</i> . <i>grahamiana</i>	514	— Thermal Expansion of Ferrous Fluoride	280
— Content of <i>Solanum khasianum</i> ..	600	Antibiotic Activity of <i>Sclerotium rolfsii</i>	94
Alkaloid Contents of <i>Solanum khasia- num</i> , Seasonal Variations in ..	187	<i>Antidesma walkeri</i> —A New Record for India	106
<i>Allescheriella crocea</i> , Occurrence of, in Coffee Estates	76	Application of Bunnett Criterion to Mechanism of Chromic Acid Oxida- tion of Secondary Alcohols ..	171
<i>Alternaria tagetica</i> Causing Blight of Marigold	370	<i>Arthrobacter</i> Species for Assay of Glutamate and Vitamins ..	237
Aluminium Alkoxides, Thermal De- composition of	566		
Amber Grain Mutants in Wheat, Protein Characteristics of ..	469		

[illegible]

PAGE		PAGE
	Chromium-51 of High Specific Activity, Preparation of	230
	Chromone, Resonance in the Pyrone Ring of	564
	Chromosome Number in <i>Apis florea</i>	186
	—s of <i>Schistocerca gregaria</i>	497
	<i>Cissus quadrangularis</i> , Active Constituents of	317
	Citral Epoxide	333
	<i>Clibanarius zebra</i> Dana, Occurrence of, in the Indian Coast	545
	<i>Clitoria ternaeta</i> , In Vitro Culture of Excised Embryonal Axes of	104
	Clonal Propagation of Mango Through Cuttings	23
	Cl ³⁵ Pure Quadrupole Resonances in Three Organic Compounds	359
	Colchicine-Gibberellin Interaction in the Control of Elongation of <i>Cucumis Hypocotyl</i>	471
	Colours of Fluorspar	297
	— — Iolite	221
	— Vision, Defects in	1
	— —, Nature and Origin of Defects in	55
	— —, The Testing of	29
	Comparative Effects of Indole-3 Acetic Acid, Kinetin, and Gibberellic Acid on the Growth of <i>Cucurbita pepo</i>	601
	Complexometric Estimation of Phosphate	568
	Compton Scattering of Gamma-Rays from Bound Electrons	540
	Conductometric Estimation of Copper with Resacetophenone-Oxime	64
	Conodonts, Record of, from India	621
	Copper (II) Ferrocyanide, Two New Complexes of, with Ethylenediamine and Propylenediamine	307
	<i>Crotalaria retusa</i> , A High Monochrotaline Yielding Strain of	546
	Crystalline Chemical Components of the Leaves of <i>Rhododendron veitchianum</i>	564
	Crystallographic Data for Some Amino-Acids, Dipeptides and Related Compounds	529
	Crystal Structures of Large Molecules, Use of Anomalous Scattering of Neutrons	87
	Cyclomorphosis in a Plankton Rotifer <i>Keratella tropica</i>	67
	<i>Cynometroxylon indicum</i> , Cuddalore Sandstones	158
	Cytological Effects of Gammexane on Somatic Chromosomes of <i>Urginea coromandeliana</i>	75
	— Features of Male <i>Spathosternum prasiniferum</i>	357
	Cytology of <i>Crinum deflexum</i>	156
	— — <i>Gomphogyne cissiformis</i>	420
	— — <i>Mylocherus viridens</i>	290
	Cytotaxonomy of <i>Chlorophytum laxum</i>	314
	Cytotoxic and Radiomimetic Activity of Irradiated Culture Medium on Human Leukocytes	403
	DALTONIAN Colour Vision	193
	Dedolomitisation	209
	Defects in Colour Vision	1
	— — — —, Nature and Origin of Degradation of Aromatic Compounds by <i>Arthrobacter</i> Species	55
	Derivatives of 5-Chloro-2-Alkylquinazolinones	58
	Determination of Palladium and Nickel in the Presence of Each Other	594
	— — Trithion with Bisdiazotised Ortho Dianisidine	175
	Dibromo Tetrakis-Thiourea Manganese (II) Complex	215
	<i>Didymobotryum atrum</i> and <i>Lasmenia ficina</i> from Coffee Estates in Mysore	203
	Dielectric Behaviour at 3 cm. of Monosubstituted Anilines	131
	— Constants of Aqueous Solution of Transition Elements	360
	Differential Thermal Analysis of Unsupported and Supported Iron Oxide Catalysis	201
	Diploid and Tetraploid Spermatogonia in <i>Bombyx mori</i>	253
	Dipole Moments of Cholesteryl Compounds	265
	<i>Discosia poonensis</i> from India	229
	Dislocation Pile-Ups in Antimony Single Crystals	416
	Distribution of Total Alkaloids in <i>Datura</i> Species/Varieties	592
	Dormancy in Rice Seed	311
	Duality of the Retina	548
	Dwarf Strains of Pearl Millet and Their Yield Potential	111
	EFFECT of a Foreign Body on Oxygen Consumption of the Rat Uterus	355
	Egg and Miracidium of a Genarhopsid Fluke in Local Fishes	543
	Electrolytic Labelling with Iodine	102
		131

	PAGE	PAGE
Electronic Absorption Spectra of 2-, 4- 6- and 7-Methyl Quinoline Vapours	230	
— — Spectrum of 2-Chloroparaxylene Vapour	616	
Electron-Microscopic Study of the Northern Black Polished (N.B.P.) Ware of India	623	
<i>Elsholtzia incisa</i> , A New Source of Thymol	604	
Embryology of <i>Elæagonus conferta</i> .. — — Pittosporaceæ	185 74	
Embryo-sac and Endosperm in <i>Andro- graphis paniculata</i>	368	
<i>Emericellopsis synnemeticola</i> var. <i>magnus</i> , A New Variety	470	
Emission Spectrum of β -Naphthol Vapour	386	
— — — <i>m</i> -Fluoroaniline in Near Ultra-violet	145	
— — — Parafluoroaniline	513	
Energy of a Charged Particle	304	
Epoxide Formation on Silver Nitrate- Alumina Column	357	
Essential Oil Contents of Root in <i>Bursera delpechiana</i>	152	
Excised Roots of <i>Phareolus aureus</i> , Mode of Culture and Growth of, In a Synthetic Medium	406	
Expression and Stability of an Induced Mutation for Ear Branching in Bread Wheat	91	
Extraction of Blue Peroxychromic Acid into Ion-Association Systems	307	
FAINTEST Observable Spectrum	83	
Fat and Carbohydrate Levels in <i>Martesia fragilis</i>	71	
Ferrous Alkoxides	593	
Field Ion Metallography	6	
Fine Structure Analysis of ^{63}Cu ^{127}I Bands	299	
Fishery Resources of the Indian Ocean	451	
Fish Remains from the Middle Palæozoic of the Kashmir Himalayas	95	
Fission-Track Ages of Indian Micaceous Flavandiol, Action of Periodate on, Fluorspar, the Colours of	509 40	
— Occurrence Near Kotesluar, Dhar Forests, M.P.	297	
Foliar Sclereids in Three Dicotyle- donous Genera	411	
— Venation of Scrophulariaceæ	380	
Food of <i>Planispira nagporensis</i>	315	
Fossil Dicot Wood from Dudukur Near Rajahmundry	179 257	
Fossil Distortion Caused by Tectonic Deformation in the Kashmir Himalayas	341	
— Fruit from the Deccan Intertrappean Beds of Mohgaonkalan	208	
— Vertebrates in Tirunelveli District, Occurrence of	622	
— Wood Resembling <i>Bauhinia</i> from the Cuddalore Series of South India	575	
Friedel-Crafts Reaction, a Modification of	255	
GAMETOPHYTES (Male and Female), and Endosperm in <i>Vaccinium leschenaultii</i>	130	
Generalised Mean-Square Amplitudes of Vibration and Shrinkage Effect in $\text{CF}_3\text{C}:\text{CH}$ and $\text{CF}_3\text{C}:\text{CD}$	562	
<i>Ganoderma applanatum</i> and <i>Stereum princeps</i> , Chemical Components of	205	
Genus <i>Pæcilomyces</i> from India	396	
Geophysical Studies of the Ramnad Basin, Madras State	197	
Germination of Sclerotia of Sugarcane Ergot	472	
<i>Gossypium barbadense</i> , Use of Haploids in, as a Source of Anucleoids	34	
Graptolites from the Kashmir Himalayas	128	
Gravimetric Determination of Molyb- denum (VI) in Presence of Titanium and Zirconium	122	
Green Algæ from Saurashtra Salt Works	180	
— Garnet from the Bandite Series, Mysore	127	
Griseofulvin and Sulphanilamide, <i>In vitro</i> Effects of, on <i>Cochliobolus miyabeanus</i>	506	
HABIT Modification of Copper Electro- deposit Caused by Chloride Ions	235	
Hæmolymph Proteins and Reproduction in <i>Periplaneta amaricana</i>	587	
<i>Halammohydra octopodides</i> , Occurrence of, in Indian Waters	129	
Hatchability of <i>Meloidogyne javanica</i> Eggs, Effect of Chemicals on	598	
<i>Helminthosporia</i> , a Revision of Some Graminicolous Species of	352	
<i>Helminthosporium</i> Disease of Bajra, — <i>rostratum</i> on Ragi	240 446	
Herqueinone, Conversion of, to Atrovenetin	66	
Heterocyclic Compounds (X): Reaction of Indoles with Chalcones	123	

	PAGE		PAGE
<i>Hilsa ilisha</i> , the Indian Shad, in the Sea	329	Intensity of 1.114 Mev Gamma Transition in the Decay of Zn ⁶⁵ to Cu ⁶⁵ ..	384
Hinokiflavone Pentamethylether, Synthesis of	64	Internal Conversion Coefficient of 800 keV Transition of Ba-134 ..	435
Histochemical Staining 'Differences in the Myelins of Nervous Tissues of Birds	153	Introgression in <i>Paspalidium</i> ..	522
— Studies on the Interrenal Tissue of <i>Ophicephalus punctatus</i>	596	Iodine-131 Labelled Hippuran, Preparation of	16
Hollyhock (<i>Althea rosea</i>), <i>In vitro</i> Production of Petals from Anthers ..	574	Iolite, Colours of	221
Hybrid Jowar, the Best Complex of, in Mysore State	214	Ionic Regulation in <i>Marphysa gravenyi</i> Southern	72
— Necrosis in Bread Wheat	547	Isolation of 1, 2-Dimethyl 4, 5-Diamino Benzene in a Heterokaryon of <i>Aspergillus nidulans</i>	336
Hydrogen-Bonding in Pyrrole-Tertiary Amide Complexes	301	Isotope Shifts (C ³² S-C ³⁴ S) in the Bands CS Molecule	485
— Chemisorption on Supported Iron Powder	567	Isotopically Labelled Organic Iodo-compounds for Medical Use ..	401
IDENTIFICATION of Mustard Oil and Castor Oil in Other Oils by Paper Chromatography	43	JAPANESE Encephalitis, Specific Identification of	455
Igneous Rocks, Occurrence of Some Interesting, in North Arcot District ..	550	KARHARBARI Plant Fossils in Daltonganj and Jainti Coalfields, Bihar ..	412
Indian Academy of Sciences: Thirty-First Annual Meeting	31	Karyomorphological Factors Favouring the Incidence of Chromosomal Interchanges	414
— — — — — Second Annual Meeting ..	537	Karyomorphology of <i>Limnophyton obtusifolium</i>	19
— Ocean, Fishery Resources of	451	Kinetics of Bromination of Aromatic Compounds	408
Induced Gut Tumours in Cockroaches ..	624	— — Oxidation of Allyl Alcohol by Ceric Nitrate in Nitric Acid ..	254
— Mutation for Ear Branching in Wheat	91	— — — Benzyl Alcohol by Aqueous Ceric Ions	332
Induced Polyploidy in <i>Methra</i>	22	LAMETA Series of Madhya Pradesh, Some Observations on	317
— Tetraploidy in Grape	445	Lamprophyric Dyke from Channakal Betta, Mysore	96
Induction of Closed Anther Character in Tomato Cultivars	292	Laser Excitation Raman Spectrometer ..	555
— — Gastric Ulcers by Acid Feeding in Toad	433	Lead Content of the Deccan Traps ..	362
Influence of the Submandibular Salivary Gland on Growth	542	Leaf Blight—A New Disease of Jasmine	394
Infrared Absorption Spectra of Nitrate Complexes of Cu (II) and Ag (I) ..	618	— Disease of Avocads Caused by <i>Colletotrichum gloeosporioides</i> ..	239
— — — Thiocyanato Complexes of Manganese (II)	462	Leafhopper Infestation, Influence of, on Pigment Contents of Castor Varieties	572
Inheritance of Host Reaction to Races A 20 and A 22 of <i>Ustilago avenae</i> ..	493	Leaf-Spot Disease of <i>Sesamum</i> , a New <i>Lethacotyle</i> (Monogenea) and Its Post-oncomiracidial Larva, a Rare Record ..	416
Inhibitor in the Seedcoat of Ragi	612	Life-Cycle of <i>Philophthalmus</i> , Experimental Demonstration of	366
—y Effect of Hemicholinium on Adaptation of Guinea Pig to Aerosals of Acetylcholine and Histamine	157	Lifetimes of 1554 and 1289 KeV levels W (182)	384
Initial Susceptibility and Constructed Rayleigh Loops of Some Basalts ..	534		
Insensitivity of the Prepuberal Rhesus Monkey Testis to Serotonin and Histamine	365		
Insoluble Oxalate in Bathua Leaves ..	207		

	PAGE		PAGE
Lignans: Synthesis of Analogues of Galbulin	206	Multiple Resistance to Heat, Draught, Frost, Charcoal Rot and Nematode in Potato	494
Lipolysis of Peanut and Cotton Seed Fats, <i>In vivo</i> Mechanism of ..	302	— Shoot Formation from the Embryonal Mass of <i>Fogopyrum sagittatum</i> ..	18
<i>Longiunguis sacchari</i> , Record of a Braconid Parasite of	602		
<i>Loranthus</i> on Teak, Selective Control of Lower Siwalik Plants from Near Jawalamukhi, Punjab	444	<i>Neitheia morrisi</i> from the Bagh Beds, Madhya Pradesh	338
Low-Lying Even-Parity Levels of F ¹⁸ Nucleus	209	<i>Nelumbium speciosum</i> , Chemical Examination of the Flowers of ..	176
Lunar Surface, An Hypothesis on the Evolution of	38	Neodymium Filter, Observations with Neolith from Son Valley	271
MAGNETIC Susceptibility of Basaltic Rocks	225	<i>Niesslia</i> , A New Species of, from India Night Sky, The Spectrum of ..	395
— — — Copper Complex of Mercapto Succinic Acid	534	<i>Nitella terrestris</i> , A New Variety of Nitrogen Losses from Upland Paddy Soils Reducing by 2-Chloro-6 (Trichloromethyl) Pyridine ..	137
Magnetosphere, the Mirror Point Distri- bution in	63	N.M.R. Study of Hexamethylenetetra- mine	630
Male Sterile Barley	139	Nodal Vessels in <i>Dioscorea alata</i> ..	539
Mannuronic Acid in the Cell-Wall of <i>Riccardia</i>	289	Normal Co-ordinate Analysis of the In-Plane Vibrations of Fluorochloro and Fluorobromo Benzenes ..	183
<i>Marchantia</i> , Occurrence of, at Sriranga- pattana, Mysore	20	Nuclear Magnetic Resonance in Liquid In-Bi System	331
Mass Spectrometry and Its Appli- cations to Organic Chemistry (Rev.)	497	— — — of Co ⁵⁹ in Pentammine Co (III) Complexes	405
Meiotic Study in <i>Pennisetum pedicel- latum</i>	349	<i>Nypa</i> Fruits from the Deccan Inter- trappean Beds of Mohgaonkalan ..	37
Mercurated Thiazolidones as Antifungal Agents	343		421
Merozoites from Globidial Schizonts in Abomasum of Indian Goats ..	541		
Metopiron, Effect of Intratesticular Administration on the Testis of Gerbil	103	OCCURRENCE of an Aberrant Cnidarian <i>Halammohydra octopodides</i> in Indian Waters	129
Micas, Indian, Fission-Track Ages of <i>Microsphaera</i> , A New Species of, on <i>Hamiltonia suaveolens</i>	521	— — — — Kinorhynch <i>Cateria styx</i> in Waltair Beach Sands	212
Minor Flavonoid Components of the Heartwood of <i>Prunus domestica</i> ..	509	— — <i>Botryococcus</i> in the Miocene Lignite of South Arcot District ..	367
Modification of Floral Parts into Tubers in Potato	370	— — Calcareous Oolites in the Krol Series of the Simla Hills	441
Molecular and Intramolecular Relaxa- tion in Substituted Naphthalenes ..	409	— — Dorsal Organ in <i>Cingalobolus</i> <i>blgnioni</i>	393
Molybdenum (VI) Complex of 3- Phenylidapnetin	213	— — Nematode <i>Hoplolaimus indicus</i> in W. Bengal	597
Morphological and Anatomical Studies in Helobiae	304	— — Nereites, A Fossil Polychaet, in Rajasthan	624
Morphology of Anther Tapetum of Angiosperms	557	— — 3, 4, 2, 4, 6-Pentahydroxy Chalkone in the Petals of <i>Helichry- sum bracteatum</i>	609
Mosaic Disease of Phlox in India ..	250	Mikir Hills, Assam	440
Mucopolysaccharides in the Caudal Gland of <i>Cryptozona semirugata</i>	427	— — 3, 4, 2, 4, 6-Pentahydroxy — — 22-Dihydroergosterol in <i>Poly- porus pargamenus</i>	515
Multicelled Trabeculae in Some Species of <i>Selaginella</i>	183	— — Vermiculites at Pauni, Bhandara District	442
	286		
	46		

	PAGE		PAGE
<i>Oidiopsis taurica</i> , Some New Hosts of	447	Physiology of Vision, the New:	
<i>Oryza</i> from China, A New Form of	278	Chapter XXXVI—The Postulated	
Oviparity in Sugarcane Aphid—		Duality of the Retina ..	111
<i>Longiunguis sacchari</i> ..	18	— — — — —: Chapter XXXVII—The	
Oxalate Status of Pusa Giant Napier		Spectrum of the Night Sky ..	137
Grass ..	125	— — — — —: Chapter XXXVIII—The	
Oxidation of Rubeanic Acid by		Adaptation of Vision to Dim Light	165
Chloramine-T ..	334	— — — — —: Chapter XXXIX—	
Oxidative Cyclisation of Some 4-		Daltonian Colour Vision ..	193
Benzylthiosemicarbazones ..	487	— — — — —: Chapter XL—The	
Oxidimetric Estimation of Sodium		Colours of Iolite ..	221
Formaldehyde Sulphoxylate ..	517	— — — — —: Chapter XLI—Photo-	
Oyster <i>Crassostrea madrasensis</i> , Fatty		graphy in Colour ..	245
Acid Composition ..	99	— — — — —: Chapter XLII—Further	
		Observations with the Neodymium	
PAPER Chromatographic Analysis of		Filter ..	271
Enzymatic Activity <i>in vitro</i> ..	443	— — — — —: Chapter XLIII—The	
— — Separation of Antioxidants in		Colours of Fluorspar ..	297
Foods ..	309	Phytotoxicity ..	273
— — Studies of Thiazoles and Thiazol-		Pigments from <i>Penicillium herquei</i>	66
lines ..	595	Pill-Millipede <i>Arthrosphera dalyi</i> ,	
<i>Parthenium hysterophorus</i> Linn. ..	181	Respiration of ..	178
Partial Double Bond Character of the		<i>Pleiochaeta</i> on <i>Cassia sumatrana</i> , A	
Bonds ..	511	New Species of ..	287
—ly Sterile Individuals in a Popula-		Plerocercoid of <i>Senga</i> Sp. from Fresh-	
tion of <i>Ageratum conyzoides</i> and		water Fish <i>Panchax panchax</i> ..	626
<i>A. houstonianum</i> ..	496	Polarographic Reduction of Copper	
Pectin Trans-Eliminase ..	503	Resacetophenoneoxime ..	202
Penicillin, Structure-Action Relation-		Pollen Morphology of a New Species	
ship of ..	335	of <i>Cuscuta</i> ..	105
Penta-Co-ordinated Cobalt (II) Com-		Polyphenolase Activity in <i>Tribolium</i>	
plexes ..	63	<i>confusum</i> ..	463
Pentaerythritol Acetate ..	391	Postulated Duality of the Retina ..	111
Phenolic Acid Pattern and the System-		Potato Varieties Tolerant to Higher	
atic Position of Aristolochiaceæ		Thermoperiods ..	143
— in Some Members of Pedaliaceæ		Precambrian Orogenic Cycles and	
4-Phenyl Coumorins as Precursors of		Tungsten Metallogeny ..	339
Neoflavanoids ..	477	Precipitation of Barium Sulphate from	
Phenyl Osazones, Chemistry of ..	323	Homogeneous Solution ..	594
Phosphate-Phosphorus Concentration		— — Beryllium from Homogeneous	
in Surface Sea-Water ..	492	Solution in Presence of Phthalate	617
Phosphorus Concentration during Red-		Preservation of Gnetum Material in	
Water Phenomenon in the Waters		Natural Colour ..	444
of Porto Novo ..	100	Proanthocyanins of <i>Bassia butyracea</i>	223
Photography in Colour ..	245	Promotion of Lateral Bud Develop-	
Physiology of Vision, the New:		ment by Ascorbic Acid ..	155
Chapter XXXII—Defects in Colour		Protein Quantity and Quality Associated	
Vision ..	1	with a Mutation for Amber Grain	
— — — — —: Chapter XXXIII—The		Colour in Wheat ..	469
Testing of Colour Vision ..	29	Proteins and Amino-Acids, Changes in	
— — — — —: Chapter XXXIV—The		Eye Lens and Cataract Formation	13
Nature and Origin of Defects in		Proteolytic Activity of Some Plant	
Colour Vision ..	55	Latex ..	42
— — — — —: Chapter XXXV—The		Proton Magnetic Resonance in the	
Faintest Observable Spectrum ..	83	Pyrone Ring of Coumarins ..	459
		Pseudobranch in <i>Tilapia mossambica</i>	413

	PAGE		PAGE
Pseudo Quartz Veins in the Gondwanas of Kanhan Valley Coal Field ..	338	Revision of Some Graminicolous <i>Helminthosporia</i>	352
Pyridine-2-Aldoxime—A New Complexing Agent for Thorium ..	461	Rhizosphere Effects of Crop Plants, on the Variations in	238
— N-Oxide Complexes of Nickel ..	361	<i>Rhododendron veitchianum</i> , Crystalline Chemical Components of the Leaves of	564
Pyrophosphate and EDTA, An Indirect Method for the Determination of	177	Rice Coleoptile Straight Growth Test for Auxin Bioassay	50
<i>Quercus robur</i> and <i>Q. incana</i> , Chemical Examination of	204	— Plant, Response of, to Blue-Green Algae and Ammonium Sulphate in Bulk Trials	482
Quinoline and Isoquinoline Complexes of Silver (I)	408	Rock Attenuation and Internal Friction as a Function of Frequency ..	491
RADIAL Particle Profile in Negative Glow Neon Plasma	582	—s, Basaltic, Magnetic Susceptibility of Rotational Analysis of D-X System of Cu^{63} I^{127} Molecule	593
Radiocarbon Dates of Samples from Historical Levels	276	SALIVARY Gland, Submandibular, Influence on Growth	542
———— N.B.P. Ware Levels ..	4	Sanidine-(Trachyte) from the Western Slopes of Rajpipahills, Gujarat ..	211
———— Southern Neolithic Sites	585	Sclerotium Wilt of Jasmine in Mysore	393
Radiosensitizing Effects of N-Ethylmaleimide on <i>Vicia faba</i>	21	Seed Viability Tests with 2, 3, 5, Tetrazolium Bromide	77
Radius of Schwarzschild Singularity in Cosmological Background ..	359	Seedling Grafting for Overcoming Interspecific Incompatibility in <i>Lycopersicon</i>	420
Raman and Infrared Spectra of Some Amides	350	Selective Catalytic Steam-Oxidation of Mixed Hydrocarbons	233
— Scattering Spectroscopy with Laser Source	555	Semi-Quantitative Theory of Resonance, Application of, in Electrophilic Substitution	620
Rapakivi Structure in the Granitic Rocks of Almora, U.P.	519	Sequestering of Iron and Aluminium by Soil Polysaccharides	259
Rare Earth Nitrate Complexes of Dimethyl Sulphoxide	389	Serotonine, Effect of, on Red Chromatophores of <i>Gelasimus annulipes</i> ..	467
— Perchlorate Adducts with Dimethyl Formamide	389	Sewage and Sludges, Minerals and B Vitamins in	247
— Pongamol Complexes, Preparation and Absorption Spectrum Studies of	12	Sex-Ratio in Fish Populations and Growth Rate	140
Rat (Bandicoot), Activity Cycle of Ratticides, Field Trial of, in Bait Boxes	544	Sexuality in <i>Ustilago scitaminea</i> ..	603
<i>Rauvolfia serpentina</i> , Occurrence of Natural Population of, in Jammu	465	Shell-Like Forms in the Basal Stage Vindhyan System	466
Reaction of Amino-Acids and Tea Quinones	132	Sialic Acid in Genital Organs of Male Rat	336
Relaxation Times and Activation Energies of Some Dipolar Mixtures	392	SiBr Band System in the Visible Region	616
— — — — Energy of Some Hydroxy Benzoic Acids	485	Sodium Chloride Tolerance by <i>Azotobacter chroococcum</i>	126
— — — —s and Averaged Mutual Velocities of Three Substituted Benzenes ..	120	Space Group and Unit Cell Dimensions of 2-Phenyl Benzoxazole	616
— — — — of Mixtures of Benzaldehydes in Benzene	15	<i>Spathosternum prasiniferum</i> , Some Interesting Cytological Features of	357
Resonance in the Pyrone Ring of Chromone	229	Spectrophotometric Studies of Molybdenum (VI) Complex of 3-Phenyldaphnetin	557
Reviews and Notices of Books : 24, 51, 78, 107, 133, 161, 188, 215, 241, 267, 293, 310, 345, 373, 397, 424, 448, 474, 499, 526, 551, 578, 605, 633	564		

	PAGE		PAGE
Spectrophotometric Uranium (VI) 3-Benzyl-4-5 Dihydroxycoumarin Complex	173	Tetrahedral Biformato Bi (Pyridino) Nickel (II)	176
Spectrum of the Night Sky ..	137	<i>Tetrallantos lagerheimii</i> Teiling, a Note on	631
<i>Sphenopteris sakragaliensis</i> , A Fern from Rajmahal Hills	69	Tetranitroazoxybenzene and Photo-induced Condensations of Polynitroaromatics	42
Spherically Symmetric Solution of Cosmological Interest	538	Tetraphyllidean Larva in <i>Eucalanus subcrassus</i> Off Waltair Coast ..	70
— — — — — Space-Times and Petrov's Classification	589	Thermal Decomposition of Aluminium Alkoxides	566
Spider, A New Species of the Genus <i>Scytodes</i> from India	627	Thiazoles and Thiazolines, Paper Chromatographic Studies of ..	595
Spider, Genus <i>Triaris</i> , A New Species of	520	Thin Layer Chromatography of Inorganic Ions	478
Spontaneous Amphidiploidy in <i>F₁</i> <i>Phaseolus aureus</i>	629	Thorium-Melanoxetin Complex—A Spectrophotometric Study ..	388
— Macromutant in Jute	631	Tolerance of an Anticoagulant by <i>Rattus rattus</i>	415
Sporogenesis and Development of Gametophytes in <i>Cordia alba</i> ..	73	Trachyte, Occurrence of, in Dhar District, Madhya Pradesh ..	286
— — — — — <i>Eriocaulon quin-quangulare</i>	262	Transamination and Heat Increment in Ruminants	337
Stearic Acid from Leaves of <i>Daphne oleoides</i>	178	Transplantation of <i>Setaria digitata</i> in a Rabbit	628
Stomatal Study of <i>Marsilea minuta</i> ..	444	Transference of Solasodine from <i>Solanum incanum</i> to <i>S. melongena</i>	439
Structure of Mundulea Lactone Isolated from the Roots of <i>Mundulea suberosa</i>	614	Trichomes in Two Species of <i>Acanthaceae</i>	263
Sub-Haploid Pollen in <i>Amaranthus</i> ..	45	Triterpenoid Components of Leaves and Pods of <i>Wrightia tinctoria</i> ..	518
Succinic Dehydrogenase Activity of Tissues of Common Freshwater Mussel	327	<i>Tryblidiella rufula</i> Causing Canker and Dieback of Lime	371
Sulphanilamide and Griseofulvin, Uptake and Translocation of, by the Rice Plant	377	Tundapathar Limestone, Morni Hills, Ambala, Punjab	286
Summer School on Electron Microscopy	519	ULTRAVIOLET Absorption Spectrum of 2-5 Dichloroaniline Vapour ..	62
Sylhet Trap, Northern Limit of ..	235	— — — — — Para-Ethyl Phenol Vapour ..	62
Sylvacarvone, on the Structure of ..	581	— Emission Spectrum of 1-2 Fluorotoluene Vapour	512
Symposia on Irreversibility and Transfer of Physical Characteristics in a Continuum	542	— — — — — 2-Fluoroaniline	360
Synthesis of α -Terthienylmethanol, a Component of <i>Eclipta alba</i>	281	<i>Ula beytensis</i> from Gujarat, India ..	150
— — 3, 7- <i>o</i> -Dimethyl Kæmpferol and 3, 7, 8- <i>o</i> -trimethyl Herbacetin ..	64	<i>Uncinula udaipurensis</i> on <i>Cordia obliqua</i>	417
— — Hinokiflavone Pentamethylether	149	Unilaterally Active Testis in Some Indian Birds	570
— — Substituted 2-(2-Furyl) Chromones	283	Upwelling in the Minicoy Region of the Arabian Sea	378
— — Sulphonyl Urethanes	252	Uranyl Ion-Itaconic Acid Complex ..	145
— — Wightin	545	<i>Uredo</i> , A New Species of, on <i>Hygrophila</i>	492
TARAXEROL from Rubber Leaves ..	422	Urinary Calculi, Spectrochemical Analysis of Trace Constituents in <i>Utricularia</i> , <i>In vitro</i> Culture of ..	48
Technique for Maintaining a Constant Level of Soil Moisture in Pot Culture Studies	559		
Tendrils of Vitaceæ, Are They Axillary?			

	PAGE		
VAPOUR-PHASE Aromatization of <i>n</i> -Heptane	118	Wheat and Barley Rusts, Development of, on Seedlings Treated with Maleic Hydrazide	523
Vertebrate Fauna in the Surma Series of Tripura	68	Wighten, Synthesis of	252
<i>Virbrio fetus</i> Organism, Isolation of, from Buffaloes	16		
Visible Bands of BiCl Molecule	484	XANTHOSINE from <i>Trifolium alexandrinum</i> Seeds	11
Vision, the New Physiology of 1, 29, 55, 83, 111, 137, 165, 193, 221, 245, 271, 297		X-Ray Analysis of Imperfections in Deformed Rhodium	583
Wax from Larvæ of <i>Laccifer Lacca</i> , Chemical Investigation of	431	YAM Beans, Chemical Components of	167
Weevil Pest (<i>Crytozemia dispar</i>) on Cotton Crop	261	ZEEMAN Effect of Bromine NQR in <i>p</i> -Bromoaniline	252

THE NEW PHYSIOLOGY OF VISION

Chapter XXXII. Defects in Colour Vision

SIR C. V. RAMAN

JOHAN DALTON who in his later years achieved fame as the founder of the atomic chemical theory presented in October 1794 a communication entitled "Extraordinary facts relating to the vision of colours" to the Manchester Literary and Philosophical Society. This was published in the Memoirs of that Society in the year 1798. The observations on which Dalton's memoir was based were those of his own visual deficiency and that of his brother in the perception of colour. Dalton said that he could distinguish in the spectrum two hues which he called yellow and blue, his yellow embracing the red, the orange, the yellow and the green of normal subjects, while his blue appeared in the part of the spectrum which follows the green; he said further that the colour described by others as the violet which appears at the end of the spectrum seemed to him to be a little different from the blue perceived by himself, being more saturated in hue.

Dalton's scientific analysis of his own personal colour perceptions laid the foundations of a subject the literature of which received vast accretions in subsequent years. The measure of attention devoted to the topic is ascribable to the interest attaching to it from diverse standpoints. The defects in colour vision described by Dalton were clearly not in the nature of a disease. They are congenital in character and are acquired by inheritance from or through the parents of the person exhibiting them. Numerous studies made on this aspect of the matter have shown that the deficiencies are far more frequent in men than in women and are indeed comparatively rare in the latter cases. Daltonism (by which name the phenomenon is still frequently referred to) may be exhibited by men to the extent of three per cent of the male population. The predominance of the males in this respect is explained by the laws of heredity: anomalies of colour vision are transmitted by the chromosomes which determine the sex. In the case of a man, if a single chromosome X carries the defect, this is sufficient to make his vision abnormal, but with the woman both the X chromosomes must be affected before the infirmity shows itself; otherwise, the woman acts simply as a carrier and transmits the defect without exhibiting it herself.

In our daily life and activities, the ability to distinguish between colours such as red, yellow, green and blue is extremely useful. There are various occupations in which the ability to recognise such colour differences is essential. Then, again, there are specialised activities in which the capacity for recognising the finer nuances of colour is extremely important. Considering all these circumstances, it is scarcely surprising that much attention has been devoted to the subject of colour discrimination as affected by the presence of defects and anomalies in colour perception. Numerous tests have been devised for the evaluation of the ability to perceive colour differences, and for the detection and classification of the various cases in which it is not so high as it normally is.

The tests for "colour-blindness" commonly in use at the present time are charts from which the person examined is asked to read out numbers which appear as arrays of coloured dots interspersed amongst dots of other colours. The colours employed are, of course, not pure spectral colours, but are of various hues and shades. The sizes of the dots, the colours in which they are printed, the way in which they are arranged, the distance from which the observer is asked to view the charts, as well as the strength and colour of the illumination employed, all play a significant role in these tests. Hence, the exact significance of the tests and even their actual usefulness are matters needing consideration.

A third reason why daltonism and other types of deficiency in colour perception have attracted much attention is the bearing of the subject on the fundamental aspects of the physiology of vision. The following questions arise: What exactly is the nature of the differences between normal and defective colour perception, and how do these differences arise? In seeking for answers to these questions, it is clearly desirable that we simplify the issues as much as possible. We may do so by limiting ourselves to the case of the pure spectral colours, deferring the more complex problems of the perception of polychromatic radiation for consideration at a later stage. We may further limit ourselves to the case of daltonism, leaving aside other known types of defect or anomaly in the perception of colour which may be

regarded as of lesser importance. These may be conveniently discussed after the characteristics of daltonism have been fully explored and elucidated.

The Nature and Origin of Daltonism.—The purpose of the present chapter is to describe new methods of study in this field and to discuss their results and their significance. We may, however, usefully begin by asking ourselves what the acceptance of Dalton's descriptions of his own colour sensations would imply in relation to the fundamental problems of colour perception. What Dalton perceived in the sector of the spectrum which we have designated as the blue sector was obviously not different from that experienced in that sector by normal observers. In the parts of the spectrum which we have designated as the red, yellow and green sectors and in which normal observers perceive these different colours, Dalton perceived only one colour termed by him as yellow. If we assume that Dalton's yellow is the same as that perceived by normal observers in the yellow sector of the spectrum, important consequences would follow. In the first place, since the sensations of green and of red were not experienced by Dalton, his yellow could not possibly have been the result of a superposition of the green and red sensations. We are thus forced to concede that yellow is a sensation which has its own independent origin. Further, since yellow is a highly luminous sensation, it can claim to be regarded as being of major importance, while red and green are only auxiliaries which can be left out without any serious impairment of the other visual faculties.

The observational evidence already on record supports the views regarding the nature and origin of daltonism set forth above. The test-charts for "colour-blindness" which are commercially available contain as the first of the series, one in which the number 12 is pictured by an array of dots of orange hue, surrounded by a field filled up with dots of a pale blue colour. This chart is read correctly and without the slightest difficulty or hesitation by all subjects, both normal and "colour-blind". This indicates that though "colour-blind" persons may confuse red and green, the blue and yellow are never mistaken for each other. In other words, blue and yellow are basic colours alike for normal persons and for the "colour-blind".

Further striking evidence that blue and yellow are perceived alike by normal and by "colour-blind" persons is furnished by the published studies of the so-called "unilateral colour-

blindness". There have been quite a few cases which have come to notice and in which colour-deficiency is much more marked in vision with one eye than with the other. In such cases, it is evidently possible for the person concerned to compare the colour-sensations experienced by him with his two eyes. It has been reported that in all such cases, blue radiation at 450 mμ and yellow radiation at 575 mμ exhibit colours which are not different as seen respectively with the two eyes. Dalton's description of the two-colour spectrum thus receives an impressive confirmation.

The Colours of Interference.—The author has devised a new method for the study of "colour-blindness" which enables the sensations of normal observers to be quickly compared with those having defective colour-vision. The person whose vision is under study is asked to view a pattern of interference colours as seen with white light and to describe in his own words what he observes. For this purpose, the most suitable set of interference colours are the well-known rings of Newton but produced on a much larger scale than usual so that no optical aid is needed to observe them and examine their characteristics. Such rings can be produced by placing two fairly thick plates of glass in contact with each other in an appropriate orientation. They are seen by reason of the fact that such plates, though intended to be quite flat, actually exhibit over extensive areas a cylindrical curvature of very large radius. The geometry of the interference pattern exhibited by the air film enclosed between two such plates is determined by their relative orientation. The fringes appear as straight lines when the axes of the cylindrical elevations on the two plates are parallel to each other; they appear as elliptic rings when these directions are inclined and as circular rings when they are exactly in the crossed positions. Circular ring-patterns exhibiting brilliant colours and covering an area 5 cm. \times 5 cm. may thus be readily obtained.

The appearance of such interference patterns, as seen by an observer with normal vision has already been described in an earlier chapter. The significant feature is that the pattern exhibits fluctuations of brightness as the principal feature and these are accompanied by colours which arise as incidental consequences of the variations of luminosity in the field. Measurements of the positions of the minima of brightness in the pattern as observed with white light agree with the positions of the minima of brightness in the same interference

pattern observed using monochromatic illumination of wavelength $579\text{ m}\mu$. For an observer with normal vision, the first few rings exhibit the successive minima of illumination very conspicuously, while the outer rings appear as circles of colour which are alternately red and green.

The interference pattern as seen by an observer, with normal colour vision, may therefore be described as a pattern of fluctuating brightness due principally to the yellow sector of the spectrum, accompanied by fluctuations of colour in which the red and green sectors manifest themselves visibly in the neighbourhood of the regions where the yellow has the minimum luminosity. It is evident that in these circumstances, the pattern would present a very different appearance to a person with normal colour vision and to one who is unable to perceive the red and the green of the spectrum.

Colour and Luminosity in the Spectrum.—Another method for testing colour-vision is for the person under study to be presented with the spectrum of a very brilliant source of white light appearing on the ground-glass screen of a constant-deviation spectrograph, arrangements being made to vary the brightness of the spectrum over a wide range of values. The subject is asked firstly to describe in his own language what he observes on the screen. He is also asked to indicate with a pointer, the exact points at which the spectrum appears to him to commence and to end, the positions where the colour in the spectrum as seen by him appears to alter, and the position or positions in the spectrum which appear to him to exhibit the maximum luminosity. These tests may be made at three different levels of spectral luminosity, one of which is very low, another medium and a third which is quite high. The low-intensity spectrum may be obtained by interposing an opal glass sheet between the source of light and the slit of the spectrograph, while the medium and high-intensity spectra are obtained without the opal glass sheet, by merely moving the spectrograph from a distant position to one much nearer the source of light.

The tests described above are very simple and can be very quickly made. They may be usefully preceded by even simpler tests, such as asking the subject to name the colours of variously brightly hued plates shown to him, then asking him to read the numbers on the test-charts of the usual kind and also to notice

and name the colours of the individual dots appearing on such charts.

Results of the Tests.—We proceed to describe the observations reported by a person who will be referred to here as C.D. He was a competent man of science and could therefore be trusted to state accurately what he himself observed. Without any hesitation, C.D. correctly named the colour of a yellow cardboard box shown to him. He immediately recognised the number 12 on the first sheet of the test-chart printed as a set of orange dots which were surrounded by a field of pale blue dots. But the other sheets of the test-chart conveyed nothing to him. When the coloured rings of the interference pattern were presented to him, he had no difficulty in counting the number of rings visible in it, which he gave as seven. But the rings appeared to him to be yellow in colour, presenting the same hue as the cardboard box mentioned above; the successive rings appeared to him to be separated from each other by darker circles. He also noticed the indications of blue appearing in the first two or three rings of the series.

C.D. also placed the commencement of a spectrum of moderate or high luminosity at the long-wave end precisely where it is placed by an observer with normal vision. But he described the parts of the spectrum where a normal observer sees red, orange, yellow and green as being yellow in colour. He also placed the point of maximum luminosity in the spectrum at the same point, *viz.*, $579\text{ m}\mu$ as an observer with normal vision. He observed the luminosity to fall off in the region of transition from green to blue as is also noticed by a normal observer. The blue of the spectrum was named by him as blue, and its termination as placed by him agreed in its position with that noticed by normal observers. The spectrum at the lowest level of luminosity did not appear to C.D. to exhibit colour at all, though to a normal observer, the green was quite clear; the red end of the spectrum had shifted towards shorter wavelengths, alike to C.D. and to an observer with normal vision. The point of maximum luminosity in the spectrum of low brightness had also shifted considerably towards shorter wavelengths and to the same extent for C.D. as to a normal observer.

It is clear from these observations that C.D. exhibited daltonism in a typical fashion. Further it is clear that his observations support the views regarding the nature and origin of daltonism set forth above.

RADIOCARBON DATES OF SAMPLES FROM N.B.P. WARE AND PRE-N.B.P. WARE LEVELS

D. P. AGRAWAL, SHEELA KUSUMGAR AND M. UNNI KRISHNAN

Tata Institute of Fundamental Research, Colaba, Bombay-5

RADIOCARBON "dates" of samples from N.B.P. levels of Ahichchhatra, Atranjikhhera and Rajghat and from Rupar are presented here. "Dates" from the protohistoric black-and-red ware levels of Chirand (Bihar), neolithic of Burzahom and P.G. Ware level of Atranjikhhera are also included. The experimental procedures used for obtaining radiocarbon dates have been described previously (Kusumgar *et al.*, 1963; Agrawal *et al.*, 1965). Some essential details are, however, summarised below for the sake of completeness.

After subjecting samples to manual cleaning they were digested in 1% HCl to remove carbonates. Sodium hydroxide treatment was given, whenever the samples were hard enough to stand it, to remove any humic acid present. The samples were converted into methane and counted in a gas-proportional counter.

Ninety-five per cent activity of oxalic acid "standard" (National Bureau of Standards) is used for the value of "modern" radiocarbon activity. Two dates have been given for each sample: the first is based on the radiocarbon half-life value 5568 ± 30 years; the second within brackets on 5730 ± 40 years. The latter is now regarded as the best working value (Godwin, 1962). All comparisons should be made on dates based on one or other of the half-life values. For converting the dates to A.D./B.C. scale, 1950 A.D. should be used as reference year (Deevey *et al.*, 1964).

GENERAL COMMENT ON DATES

Black-and-red ware of Bihar has been "dated" for the first time. The two "dates" obtained centre around the first quarter of the first millennium B.C. This suggests a broad contemporaneity with the P.G. Ware of Doab. In Atranjikhhera there is a distinct pre-P.G. Ware horizon of black-and-red ware of Banasian affinity (Gaur, private communication). The available chronology thus suggests a Banasian epicentre for black-and-red ware, from where it could have spread to Central and Eastern India as well as Doab. The probability of the equation of Banas Culture with Aryans and their subsequent spread (Agrawal, 1965) is supported by this chronology. A large number of radiocarbon dates are now available from N.B.P.

ware levels of different sites. These "dates" suggest a bracket of ca. 450-50 B.C. Thus we see that the radiocarbon dates too reflect an overlap between the P.G. Ware (maximum spread ca. 1000-400 B.C.) in the fifth century B.C. (Agrawal and Lal, 1965).

¹⁴C DATES WITH SAMPLE DESCRIPTIONS

Ahichchhatra, Uttar Pradesh, India

Ahichchhatra (Lat. $28^{\circ} 22' N$, Long. $79^{\circ} 7' E$), District Bareilly, was the ancient capital of north Panchal. The site has recently been excavated again by Dr. N. R. Banerji, Archaeological Survey of India. Samples were submitted by Shri A. Ghosh.

TF-310, N.B.P. Ware Deposits, 2050 ± 90
(2110 ± 95)

Charcoal from High Mound, Locus XI-XII, Pit No. 4, Sealed by Layer 8A, Depth 2.5 m., Field No. 177.

TF-311, N.B.P. Ware Deposits, 2360 ± 105
(2425 ± 105)

Charcoal from High Mound, Locus IX'-X', Pit No. 5, Sealed by Layer 14, Depth 3.8 m., Field No. 196. Comment: These deposits also yield P.G. Ware.

Atranjikhhera, Uttar Pradesh, India

Atranjikhhera (Lat. $27^{\circ} 42' N$, Long. $78^{\circ} 44' E$), District Etah, has a unique position in the archaeology of Doab. The site is being excavated by the Aligarh University under the direction of Shri R. C. Gaur, who submitted the samples. The excavations there have thrown considerable light on the protohistory of the area and have established the existence of a distinct pre-P.G. Ware horizon of black-and-red ware deposit. Comment: The samples mentioned below belong to the N.B.P. Ware deposits and one to late P.G. Ware levels.

TF-283, N.B.P. Ware Deposits, 2150 ± 105
(2210 ± 105)

Charcoal from Trench ARJ-4, Locus A1 (NE.), Layer 27, Depth 4.85 m., Field No. ARJ-4/64-1.

TF-284, N.B.P. Ware Deposits, 2180 ± 95
(2245 ± 100)

Charcoal from Trench ARJ-4, Locus A1 (SW), Layer 29, Depth 5 m., Field No. ARJ-4/64-2, NaOH pretreatment was also given,

TF-194, N.B.P. Ware Deposits, 2410 ± 85
(2480 ± 85)

Charcoal from Trench ARJ-4, Locus A1 (NW),
Layer 16, Depth 3.1 m.

TF-291, P.G. Ware Deposits, 2415 ± 100
(2485 ± 100)

Charcoal from Trench ARJ-4, Locus D1(SE),
Layer 6, Depth 2.50 m., Field No. ARJ-4/64-9.
Comment: The sample belongs to the late levels.

Burzahom, Kashmir, India

TF-129, Neolithic Culture, 3670 ± 90 (3775 ± 100)

Charcoal from Burzahom (Lat. $34^{\circ} 10' N$,
Long. $74^{\circ} 54' 30'' E$), District Srinagar, Trench
BZH-1, Locus XIX-XXII, Layer 13, Depth
2.9 m., Field No. BZH-1/62. Sample submitted
by Shri A. Ghosh. Comment: Several samples
have been measured from this site. The avail-
able C^{14} dates suggest a spread of ca. 2300-1500
B.C. for this northern neolithic culture.

Chirand, Bihar, India

Chirand (Lat. $25^{\circ} 45' N$, Long. $84^{\circ} 45' E$),
District Saran, is a well-known protohistoric
site of Eastern India. The site is being exca-
vated by Dr. B. S. Verma under the general
direction of Dr. B. P. Sinha, Director, Depart-
ment of Archaeology, Bihar State, who sub-
mitted the samples. Comment: The radiocarbon
dates show that this eastern black-and-red ware
is considerably later than the Banas black-and-
red ware. In view of the vast distance between
the two, there is still a possibility of the
former having been derived from the latter.

TF-336, Black-and-red Ware Deposits, 2640 ± 95
(2715 ± 100)

Charcoal from Trench CRD-VIIB, Layer 14,
Depth 8.5 m. Comment: The sample belongs
to Period IB.

TF-334, Black-and-red Ware Deposits, 2715 ± 120
(2795 ± 125)

Charcoal from Trench CRD-VIIB, Layer 18,
Depth 12.5 m. Comment: The sample belongs
to Period IA.

Dharnikota, Andhra Pradesh, India

TF-246, Early Historic Period, 2355 ± 95
(2425 ± 100)

Charcoal from Dharnikota (Lat. $16^{\circ} 34' 45'' N$,
Long. $80^{\circ} 24' 21'' E$), District Guntur, Trench
DKT-1, Locus XXXVI-XLII, Layer 11, Depth
6.55 m. Sample submitted by Shri A. Ghosh.

Kakoria, Uttar Pradesh, India

TF-179, Megalithic Habitation Area, 195 ± 90
(200 ± 95)

Charcoal from Kakoria (Lat. $25^{\circ} 3' N$, Long.
 $83^{\circ} 11' E$), District Varanasi, Trench KKR-I-A,
Locus 0-III, Pit E sealed by Layer 1, Depth
0.7 m., Field No. KKR-1(V)-63/1502. NaOH
pretreatment was given. Sample submitted by
Prof. G. R. Sharma.

Rajghat, Uttar Pradesh, India

Rajghat (Lat. $25^{\circ} 18' N$, Long. $83^{\circ} 1' E$),
District Varanasi, is a well-known site on the
banks of River Ganga. The site was excavated
by the College of Indology, Banaras Hindu Uni-
versity, under the direction of Shri A. K. Narain
who submitted the samples.

TF-293, N.B.P. Ware Deposits, 2370 ± 105
(2440 ± 110)

Charcoal from Trench RGT-XI, Locus
XI-XII, Layer 11, Depth 9.45 m., Field No.
RGT-XI/1963-64-S. No. 2. Comment: The
sample belongs to early phase of N.B.P. Ware.

TF-292, Black Slipped Ware Deposits, 2350 ± 95
(2420 ± 100)

Charcoal from Trench RGT-Cutting B, Locus
0-II', Layer 6, Depth 5.9 m., Field No. RGT-
Cut, B/1963-64-S. No. 5. Comment: In the
preceding layer there is evidence of flood.

Rupar, Panjab, India

TF-213, N.B.P. Ware Deposits, 2275 ± 100
(2340 ± 105)

Charred wood from Rupar (Lat. $30^{\circ} 58' N$,
Long. $76^{\circ} 32' E$), District Ambala, Trench
RPR-1, Locus 0-VIII, Layer 26, Depth not
given, Field No. RPR1-1710. Sample sub-
mitted by Shri A. Ghosh.

ACKNOWLEDGEMENTS

The authors are beholden to Prof. D. Lal for
his guidance throughout this work.

1. Agrawal, D. P., Kusumgar, Sheela and Lal, D.,
Curr. Sci., 1935, **34**, 394.
2. —, C^{14} Dates, Banas Culture and the Aryans
(In press).
3. — and Lal, D., Radiocarbon Dating in Indian
Archaeology (In press).
4. Deevey, E. S., Flint, R. F. and Rouse Irving,
Radiocarbon (Editorial Statement), 1964, **6**.
5. Gaur, R. C (Private Communication).
6. Godwin, H., *Nature*, 1962, **195**, 984.
7. Kusumgar, S., Lal, D. and Sharma, V. K., *Proc.*
Ind. Acad. Sci., 1963, **58**, 125.

FIELD ION METALLOGRAPHY

S. RANGANATHAN

*Inorganic Materials Research Division, Lawrence Radiation Laboratory,
University of California, Berkeley, California*

1. INTRODUCTION

THE field ion microscope^{1,2} has a resolution of 2–3 Å and promises an understanding of all phenomena important in physical metallurgy in terms of the basic structural unit—the atom. In the fifteen years that have elapsed since Professor Müller³ developed this unique tool, exciting advances have occurred. Amongst these one may point to the first direct observation of vacancies and interstitials,¹ a theory for the atomic configuration at high angle boundaries,⁴ the study of radiation damage in atomic detail⁵ and an atomic view of surface diffusion.⁶ This article discusses the place of the field ion microscope on the armoury of the metallographer in terms of its past achievements and future potential.

The field ion microscope is inherently a simple instrument (Fig. 1). The specimen is

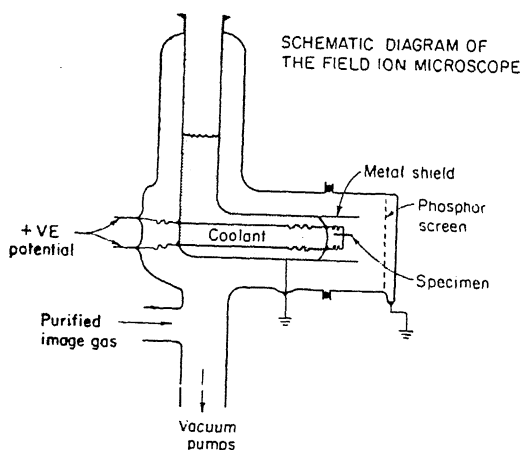


FIG. 1. A schematic diagram of a field ion microscope-tube.

usually in the form of a thin wire and has a sharp tip at the end (radius of ~ 100 Å). The microscope is evacuated to a pressure of 5×10^{-8} torr and the specimen is cooled with liquid nitrogen. Recently considerable work has been done using liquid neon, hydrogen and helium which achieve lower temperatures and lead to improved image quality. An image gas, usually helium, neon or hydrogen⁷ is admitted to the microscope at a pressure of a few microns.

A high positive potential is applied to the specimen. High field regions, F_0 , exist over protruding atoms on the surface of the specimen. The helium gas is ionized over these regions and then the helium ions form an image on a fluorescent screen at a few centimeters from the specimen. The image is approximately a stereographic projection of the tip. At higher fields, F_0 , the metal atoms themselves are ionized and the surface layer can be removed by this process, known as field evaporation. It is obvious that for successful field ion microscopy $F_0 \gg F_e$. For a given metal this condition can be achieved by either lowering the temperature or by changing over to an image gas of lower ionization potential. Thus there is no serious limitation on the metals that can be imaged. With the use of an image intensifier Meland and Müller⁷ have succeeded in obtaining images from twenty-four metals. These include the refractory metals, like tungsten and iridium and the less refractory ones like copper, gold, and iron. As a technical feat of no mean order, they have also obtained images from aluminum and tin.

2. APPLICATIONS

The field ion microscope had found direct applications. In chemistry it has been used to study absorption and corrosion.¹ Biophysicists are engaged upon the task of getting images from macromolecules. The microscope is firmly established as a valuable tool for metallography due mainly to the efforts of Professor Müller and his colleagues in Pennsylvania and D. G. Brandon and his co-workers at Cambridge. The following is a brief summary of their results on lattice imperfections, alloys and radiation damage. It is convenient to regroup them under crystallography, composition and topography. These three terms serve to characterize the state of the metal and relate it to its mechanical properties—the aim of the metallographer.

2.1. Crystallography

Figure 2 shows the helium field ion micrograph of a tungsten specimen of about 300 Å radius of curvature. Each bright spot corresponds to a single atom on the specimen surface and the rings of atoms are the edges of planes in the crystal lattice. (110), (112), (100) and (111) planes appear prominently as is to be

expected from a consideration of the atomic density of these planes. In the case of a fcc metal like iridium (111), (100), (113) and (110) planes predominate.

The distribution of lattice sites on the various crystal planes has been tackled on a purely geometrical basis by Nicholas.⁸ As part of this programme Moore⁹ has tried to account for the pattern in a field ion micrograph. His analysis is elegant. A sphere was imagined to cut an infinitely extended crystal and all the material outside the sphere removed. A computer was used to plot in orthographic projection the position of atoms that are within a certain distance from the surface of the sphere. The resulting pattern had a striking resemblance to the field ion image. The reverse process of feeding information from field ion images into computers holds exciting possibilities of making full use of the 10^4 bits of information inherent in each field ion micrograph.

arises from the differing work functions of various planes. Besides, details of the electronic structure at the surface of metals are only beginning to be understood. Field ion microscopes can play a useful part in elucidating these details.

The geometrical information in a field ion micrograph is easily evaluated. Indexing of the various planes can be done by using symmetry considerations. The number of rings can be counted and this can be used to find out tip radius, magnification, etc. Defects can also be analyzed. Field evaporation can be used for a three-dimensional reconstruction of the lattice—a truly amazing feature of the everyday operation of the microscope.

2.2. Composition

Next to the configuration of atoms, their composition is of interest. Alloy studies have been somewhat disappointing, however. A

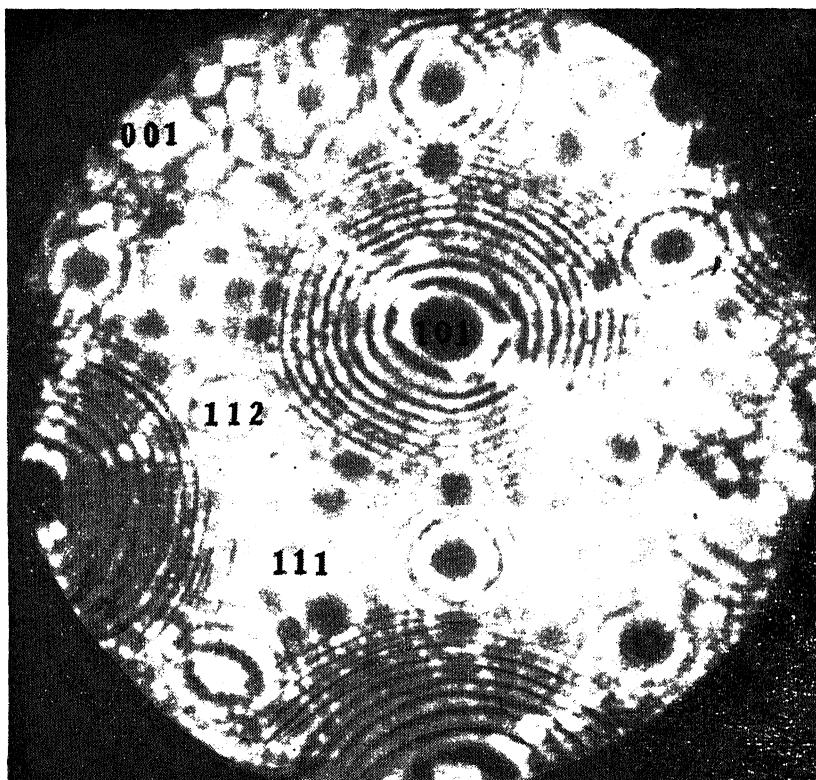


FIG. 2. Helium field ion micrograph from a tungsten specimen.

It is of interest to note that the field ion images from tungsten, molybdenum, tantalum and iron appear different though they have the same type of arrangement of atoms. This mainly

question on which the final word is yet to be said is that of distinguishing between atomic species. The alloy surface tends to be atomically "rough" and consequently the micrograph

exhibits a degree of randomness. Ralph and Brando¹⁰ found that it was possible to distinguish between alloy species by voltage analysis. If the number of spots is plotted against voltage for a given surface, the graph is linear for tungsten. In the case of tungsten 26% rhenium alloy, the graph exhibited a discontinuity and this corresponded to the amount of rhenium present. Recent work by Brenner¹¹ has shown that the method is subjective and that a more careful and possibly tedious analysis of the micrographs is necessary.

2.3. Topography

The connection between the nearly hemispherical surface of a metal tip and its field ion image is essentially topological in character. Thus there is a one-to-one correspondence between the protruding atoms on the surface of the specimen and the bright spots on the image. Vacancies are seen as such in the micrographs. The nature of contrast to be expected from an interstitial atom is not well understood. Dislocations have proved more elusive to image than grain boundaries. The extent of the con-

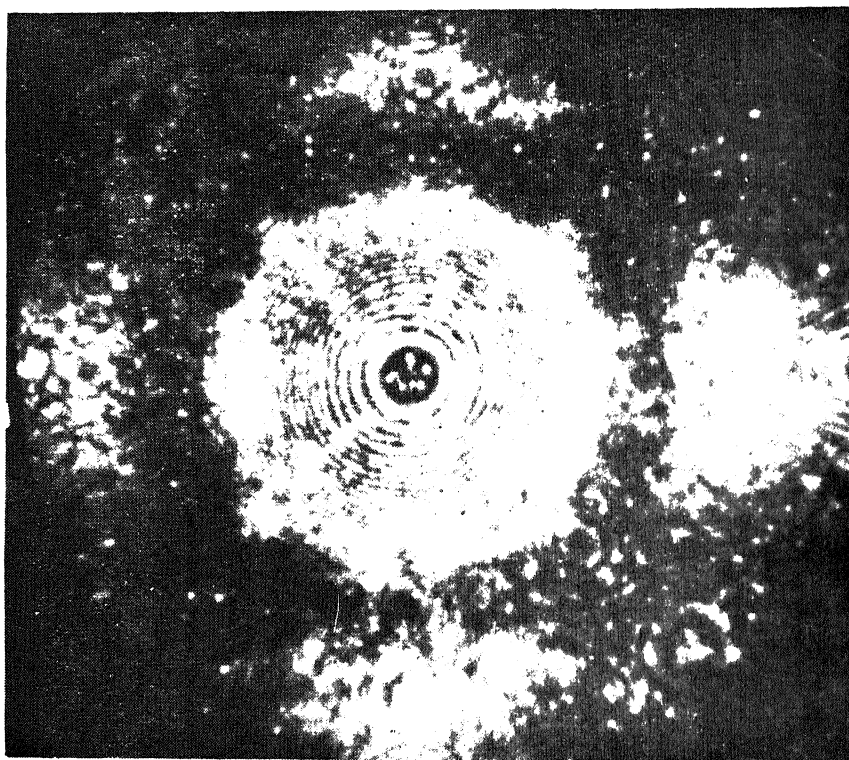


FIG. 3. Equiatomic cobalt-platinum in the ordered state (H. N. Southworth).

While random solid solutions give rise to irregular field ion micrographs, ordered alloys give highly perfect images. Indeed it is possible to devise a new parameter for order from field ion micrographs. The study of cobalt-platinum alloys by Ralph and Brandon¹² now ranks as a classic. The equiatomic alloy has the face-centred cubic structure in the disordered state. On ordering alternate (002) planes are occupied by cobalt and platinum atoms respectively and the structure becomes tetragonal. Figure 3 brings out the beautiful symmetry in this state.

contributions of field ion microscopy to the direct observation of dislocations is only two pages in Amelinckx's recent classic on the subject. That these two pages constitute a chapter at the same time foreshadows the importance of the contribution that field ion microscopy promises.

A major contribution from field ion microscopy is the development of a theory from the atomic configuration at high-angle boundaries by Brandon, Ralph, Ranganathan and Wald.¹³⁻¹⁵ They established that high-angle grain boundaries have narrow widths and often have ledges a few angstroms in height. This

observation fits in with their theory which uses the concept of a coincidence site lattice. Rotational symmetry operations on a lattice bring it into complete self-coincidence. However, partial self-coincidence can occur for certain other rotations about an axis. Two crystal lattices related by such an angular rotation about an axis have certain common sites, located on a single lattice of larger cell dimensions, known as the coincidence site lattice. Boundaries between crystal so related can minimize their energy by following planes of dense coincidence. A grain boundary running at a small angle to this plane will take up a stepped structure such that it has a maximum surface area in the close-packed planes of the coincidence site lattice, analogous to a dislocation constrained to lie along a direction that is not a low-energy direction. The twin boundary in Fig. 4 shows the dislocation structure generated at such a ledge.⁴ A boundary not possessing

imperfections on a scale suitable for field ion microscopy. Such damage can be introduced in bulk specimens which can then be thinned and studied. Vacancies and vacancy clusters have been observed in several studies.⁵ It is also possible to introduce damage *in situ*: e.g., by placing an α -source very close to the specimen. Such experiments have dramatically brought out the damage due to the passage of an α -particle through the specimen.¹⁶ These experiments also provide evidence for channeling and focusing of the particles used for bombardment. A somewhat similar experiment where a high-energy fission fragment passed through the specimen gave the result shown in Fig. 5. The crater is nearly hemispherical and has a radius of about 250 Å.

3. DISCUSSION

Much valuable work remains to be done. Recently a number of new groups has entered

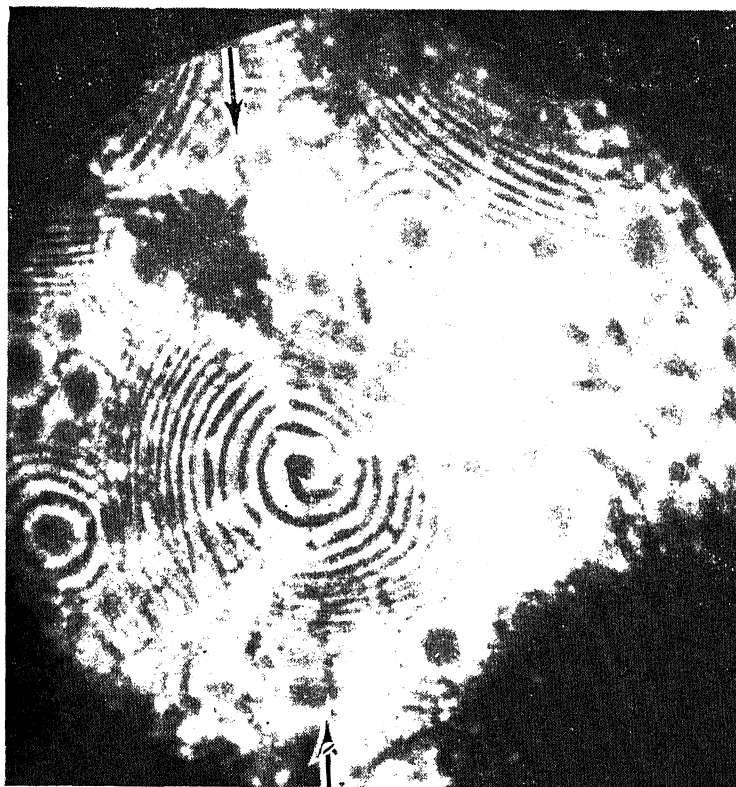


FIG. 4. Dislocation structure at a twin boundary in tungsten.

the special relationship described above can be considered to be composed of a coincidence site lattice boundary and an associated sub-boundary to account for the angular deviation.

Radiation damage can be used to introduce

the field. With the increased volume of work, one might expect new advances. While it must be conceded that the field ion microscope is not a versatile tool, there are problems to which it is uniquely suited. Some of these have already

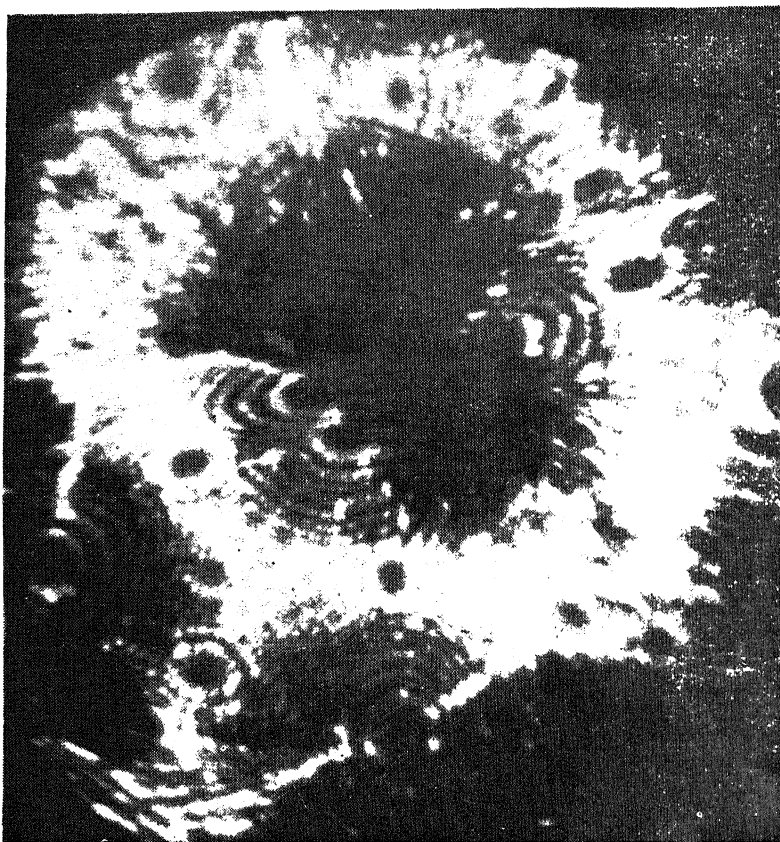


FIG. 5. Surface crater in a tungsten specimen formed by a uranium fission fragment (K. M. Bowkett).

been discussed. Future work might essentially employ less refractory metals like iron and nickel and repeat and enlarge the observations already made. As just one example of the prizes that await the patient experimenter, one might point to the imaging of the Guinier-Preston zones in a nickel-beryllium alloy by McLane and Müller. This was reported at the twelfth annual field emission symposium in Pennsylvania. (Incidentally this event celebrated on location the tenth anniversary of the development of the low temperature version of the field ion microscope.) Their micrographs show the zones as a bright band and provide clear evidence for coherence in atomic detail.

ACKNOWLEDGMENTS

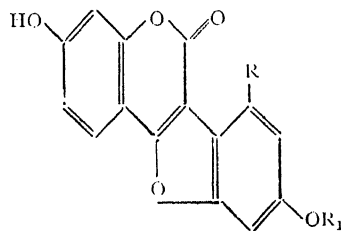
The author gratefully acknowledges discussions with members of the field ion group in Cambridge and is particularly grateful to Mr. K. M. Bowkett and Mr. H. N. Southworth for permission to use their micrographs in the text. This work was supported, in part, by the United States Atomic Energy Commission.

1. Müller, E. W., *Adv. Electron. Electron Phys.*, 1960, **13**, 83.
2. Brandon, D. G., *Brit. J. Appl. Phys.*, 1963, **14**, 474.
3. Müller, E. W., *Z. Physik.*, 1937, **131**, 136.
4. Ranganathan, S., *Ph.D. Thesis*, Cambridge University, 1965.
5. Brandon, D. G. and Wald, M., *Phil. Mag.*, 1961, **6**, 1035.
6. Ehrlich, G., *12th Field Emission Symposium, State College, Pennsylvania*, 1965.
7. McLane, B., *Master's Thesis*, University of Pennsylvania, 1965.
8. Nicholas, J. F., *An Atlas of Crystal Structures*, Gordon and Breach, Science Publishers, New York, 1965.
9. Moore, A. J. W., *J. Phys. Chem. Solids*, 1962, **23**, 907.
10. Ralph, B. and Brandon, D. G., *Phil. Mag.*, 1962, **8**, 919.
11. Brenner, S. S., *AIME Conference on High Temperature and High Resolution Microscopy*, Chicago, 1965.
12. Ralph, B. and Brandon, D. G., *Journées Internationales des Applications du Cobalt*, 9-11, June 1964, p. 76.
13. Brandon, D. G., Ralph, R., Ranganathan, S. and Wald, M., *Acta Met.*, 1964, **12**, 813.
14. Ranganathan, S. and Cottrell, A. H., *Microscopical Microscopy 1964*, Prague, 1964, p. 163.
15. Iren, J. A., *Acta Met.*, 1965, **13**, 479.
16. Sinha, M. K. and Müller, E. W., *J. Appl. Phys.*, 1964, **35**, 1256.

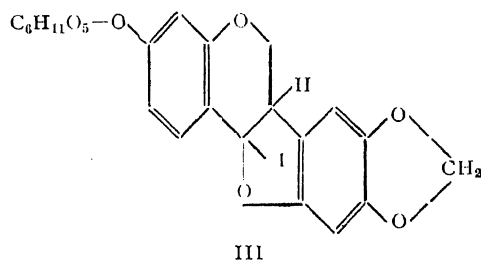
LETTERS TO THE EDITOR

XANTHOSINE FROM *TRIFOLIUM ALEXANDRINUM* SEEDS

PAST work on several species of *Trifolium* has revealed the presence of different types of compounds, the most recent among which are coumestrol¹ (I), trifoliot² (II), and trifolirhizin³ (III). In connection with our studies on 3-phenylcoumarins we have now undertaken a chemical investigation of *Trifolium alexandrinum*. It is also known as Egyptian clover and is not native to India. The plant is grown during the winter months. For the present work the seeds were obtained from the Indian Agricultural Research Institute, New Delhi.



- I: $R=R_1=H$
II: $R=OH$; $R_1=CH_3$



Petroleum Ether Extract: β -Sitosterol.—Finely ground sample was extracted in succession, in a soxhlet, with petroleum ether, ether and alcohol. A final aqueous extract was also made. The oil obtained from the petroleum extract yielded, after chromatography over neutral alumina, β -sitosterol, m.p. 136–38°. This compound has been isolated earlier⁴ from the same material.

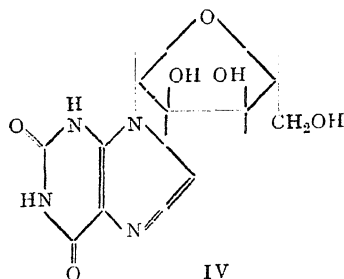
Ether extract yielded a mixture which could be resolved into methanol-soluble and methanol-insoluble fractions. The latter, m.p. 262–65° (Found: C, 70.7; H, 10.7%) was a crystalline optically active ($[\alpha]_D^{19} = -54.3^\circ$ in pyridine) compound answering the Lieberman-Burchard

test. The ultra-violet spectrum in ethanol had maxima at 246, 250 and 262 m μ . The quantity was, however, too small for detailed studies. The methanol-soluble fraction appeared to be a mixture of flavonoids or related compounds but its resolution was difficult. It is being examined further.

Alcoholic Extract: Xanthosine.—The alcoholic extract on concentration deposited a colourless nitrogenous compound which could be readily crystallised from hot water. It did not melt up to 340° C. and exhibited a large negative rotation in pyridine $[\alpha]_D^{19} = -106^\circ$. It had the molecular formula $C_{10}H_{12}O_6N_3$, 1 H₂O. Tests for alkaloids, amino-acids or peptides were negative. It answered the Molisch test but did not reduce Fehling's solution. On hydrolysis with 6 N hydrochloric acid it yielded glycine as the only recognisable product. Its ultra-violet spectrum in 0.1 N alkali $\{\lambda_{max}, [\log \epsilon] 248 (4.06) \text{ and } 277 (4.01) m\mu\}$ was significantly different from that in 0.1 N hydrochloric acid $\{\lambda_{max}, [\log \epsilon] 235 (3.93) \text{ and } 261 (3.97) m\mu\}$. The absorption curves resembled those of typical purines and were particularly similar to those of 9-methylxanthine and xanthosine.⁵ The infra-red spectrum was also characteristic of purine derivatives.⁶

Boiling with 7% sulphuric acid yielded D-ribose which was identified by paper chromatographic comparison with an authentic sample. The free purine base (m.p. > 340°) could be obtained in a pure state by milder hydrolysis using 1 N acid and boiling for an hour. It has the following spectral characteristics: $\lambda_{max}^{0.1 N NaOH} 282 m\mu$ and $\lambda_{max}^{0.1 N HCl} 263 m\mu$. Circular paper chromatographic examination with butanol-water (86 : 14) showed the presence of one component ($R_f : 0.18$). These properties corresponded to those of xanthine. The identity was confirmed by the preparation of the perchlorate, m.p. 262–63°. These results showed that the compound isolated from *T. alexandrinum* seeds is xanthosine (IV). The identification has been confirmed by comparison with a sample of xanthosine obtained from guanosine by nitrous acid treatment.⁷ While the occurrence of xanthine in plants is fairly widespread, the present study seems to be the first report of isolation of free xanthosine from a plant source. Two other purine derivatives have been reported earlier in some other species

of *Trifolium*, guanosine from *T. pratense*⁸ and uric acid from the seeds of *T. officinalis*.⁹



Aqueous Extract: Galactomannan.—Treatment of the aqueous extract with Fehling's solution yielded an insoluble copper complex. The complex was decomposed by treatment with dilute hydrochloric acid. Subsequent dilution with ethanol yielded a colourless polysaccharide which could be purified by dissolution in water and reprecipitation with ethanol. It exhibited positive rotation ($[\alpha]_D^{19} + 72^\circ$) in water. On hydrolysis it yielded galactose and mannose thus showing that it was a galactomannan.

Dept. of Chemistry, N. R. KRISHNASWAMY.
University of Delhi, T. R. SESHADRI.
Delhi-7. B. R. SHARMA.

September 7, 1965.

1. Bickoff, E. M., Lyman, R. L., Livingston, A. L. and Booth, A. N., *J. Amer. Chem. Soc.*, 1958, **80**, 3969.
2. Livingston, A. L., Bickoff, E. M., Lundin, R. E. and Jurd, L., *Tetrahedron*, 1964, **29**, 1963.
3. son Bredenberg, J. B. and Hietala, P. K., *Acta Chem. Scand.*, 1961, **15**, 696.
4. Salah, M. K. and El-Arady, M. M., *J. Pharm. Sci. U.A.R.*, 1961, **2**, 123; *Chem. Abst.*, 1963, **59**, 4001.
5. Gulland, J. M., Holiday, E. R. and Macrae, J. F., *J. Chem. Soc.*, 1934, p. 1639; Cavalieri, L. F., Fox, J. J., Stone, A. and Chang, N., *J. Amer. Chem. Soc.*, 1954, **76**, 1119.
6. Blout, E. R. and Fields, N., *J. Biol. Chem.*, 1949, **178**, 335; *J. Amer. Chem. Soc.*, 1950, **72**, 479.
7. Gulland, J. M. and Macrae, T. F., *J. Chem. Soc.*, 1953, p. 667.
8. Schulze, E. and Bosshard, E., *Z. Physiol. Chem.*, 1886, **10**, 80; *J. Chem. Soc. Abstr.*, 1886, **50**, 157.
9. Fosse, R., De Graeve, P. and Thomas, P. E., *Compt. rend.*, 1932, **194**, 1408.

PREPARATION AND ABSORPTION SPECTRUM STUDIES OF RARE EARTH PONGAMOL COMPLEXES

RARE EARTH chelates have recently received considerable attention because of their possible application in the development of Lasers.¹ Much work has been done on the rare earth complexes of diketones, their preparation,²

their spectral properties³⁻⁴ and on their fluorescence spectra.⁵⁻⁶ In a previous communication⁷ from this laboratory the preparation and spectral properties of Europium pongamol complex were reported. In the present communication the preparation and spectral data of Samarium, Dysprosium, and Ytterbium chelates with pongamol are reported.

Preparation.—A weighed amount of hte rare earth oxide (99.9%) was dissolved in A.R. grade hydrochloric acid and the solution was evaporated on a steam bath to dryness. The dry mass was extracted with absolute ethanol (20 ml.) and a calculated amount of pongamol in absolute ethanol (30 ml.), mole ratio 1 : 3, was added to the rare earth chloride solution. The pH of the solution was adjusted by the addition of alcoholic ammonia just short of precipitation of the rare earth hydroxide. The precipitate obtained was filtered, washed with a little alcohol, dissolved in benzene and the solution was evaporated at room temperature. The compound obtained was vacuum-dried. The elemental analyses of the chelates indicate that the metal to ligand ratio is 1 : 3.

Spectral Data.—The absorption spectra of the ligand and the chelates in the ultraviolet region were recorded using Hilger-Watts spectrophotometer and in the infrared region using a Perkin Elmer Model 137 infracord. The compounds were examined as solids in Nujol mulls.

In the ultraviolet region the ligand in chloroform exhibits two absorption band maxima one at 350 mμ and the other at 250 mμ. In the present investigation the study of the absorption spectra of the chelates is confined to solutions in chloroform as the chelates are insoluble in methanol and ethanol. In the chelates investigated two band maxima could be located at 350 and 250 mμ, while a large intensification could be noticed in the relative ε values, in the case of Samarium and Dysprosium chelates. The λ_{max} and ε_{max} values are detailed in Table I.

In the visible region the ligand has no characteristic absorption. The characteristic band maxima of Samarium ion at 402 mμ could not be located. However the characteristic band maxima of Dysprosium ion at 910 mμ (ε value 3.9) and that of Ytterbium ion at 980 mμ (ε value 5.1) could be located.

In the infrared region the diketone now investigated showed two bands at 1600 cm.⁻¹ and 1550 cm.⁻¹ These may be due to the enol-chelate and the perturbed carbonyl respectively. In the infrared spectra of metal diketonates

studied by Morgan⁸ and Lecomte,⁹ a strong absorption band was noticed between 1562 and 1550 cm^{-1} in a series of eleven acetylacetonates; this was attributed to carbonyl group weakened by the resonance between C=O-M and C=O...M. A second band near 1515 cm^{-1} is located which was attributed to the C=C stretching. In the rare-earth chelates now investigated two strong bands are located between 1550 and 1500 cm^{-1} . These may be attributed to C=O and C=C absorption respectively. The enol-chelate band, exhibited by pongamol at 1600 cm^{-1} , could however be located in all the three chelates.

TABLE I

Absorption bands of rare earth pongamol chelates

Substance		Chloroform	
		$\lambda_{\text{max}}, \text{m}\mu$	ϵ_{max}
Pongamol	..	350	24,110
		250	23,040
$\text{Sm}(\text{C}_{18}\text{H}_{13}\text{O}_4)_3$	..	350	71,610
		250	60,640
$\text{Dy}(\text{C}_{18}\text{H}_{13}\text{O}_4)_3$	..	350	58,130
		250	53,650
$\text{Yb}(\text{C}_{18}\text{H}_{13}\text{O}_4)_3$	..	350	27,240
		250	27,240

The authors are grateful to Prof. N. V. Subba Rao for his keen interest. One of the authors (V. R. R.) is grateful to the Council of Scientific and Industrial Research, New Delhi, for financial assistance.

P. RADHAKRISHNA MURTY.
V. RAMACHANDRA RAO.*

Department of Chemistry,
Osmania University,
Hyderabad, India, September 13, 1965.

* Pool Officer.

1. Schmitschek, E. J. and Schwartz, E. G. K., *Nature, Lond.*, 1962, **196**, 832.
2. Sacconi, L. and Ercoli, R., *Gaz. Chem., Ital.*, 1949, p. 731.
3. Moeller, T. and Frinch, U. L., *J. Inorg. and Nucl. Chem.*, 1956, **2**, 164.
4. Ramachandra Rao, V., Purushotham, D. and Raghava Rao, Bh. S. V., *Anal. Chem. Acta*, 1965, **33**, 182.
5. Reike, F. and Allison, J. *Chem. Phys.*, 1962, **37**, 3011.
6. Von, R. E. and Crosby, G. A., *J. Mol. Spectr.*, 1962, **8**, 315.
7. Radhakrishna Murty, P. and Ramachandra Rao, V., *Ind. J. Chem.*, 1965, **3** (7), 321.
8. Morgan, G. T., *U.S. Commission A.E.C.D.*, 1949, 12659, 16.
9. Lecomte, J., *Disc. Faraday Soc.*, 1953, **9**, 125.

CHANGE OF PROTEINS AND AMINO-ACIDS IN THE LENS OF THE EYE WITH PROGRESSIVE AGE AND CATARACT FORMATION

THE development of cataract at old age has often been observed in human beings as well as in other species of animals such as rabbits, rats, monkeys, horses, etc.¹ The nature of the primary biochemical changes that initiate its formation is however not clearly understood. The reduction of crystalline content in the lens with a concomitant increase in insoluble protein has been suggested by Jess² to be the cause of cataract formation. The slow and gradual oxidation of -SH groups (of soluble proteins) to -S-S bonds which leads to the formation of albuminoid has been considered to be the cause of experimentally induced cataract.³ Since the cause of senile cataract is still unknown we would like to present some of our findings which may explain the cause of development of opacity at old age.

The lenses at the various stages of their growth and development were obtained from rabbits, bred and raised in the animal house attached to this Institute. Senile cataracts were supplied by the Ophthalmology Department of this Institute and the normal human lenses were obtained from apparently healthy normal persons within 3-6 hours of their death, occurred due to accidents.

The results of Table I indicate that normally six to eight free amino-acids are found in chromatograms of normal young rabbit lens; the number is being gradually decreased with age and in old rabbit lens no free amino-acid could be detected. These results are illustrated in Table I. In still-born baby's lens only five free amino-acids are found and only two of them can be seen in adult human lens whereas none of them can be detected in the chromatograms of very old human lens and senile cataract. Detailed result is communicated elsewhere.⁷

A comparative study of the electrophoretic patterns of soluble proteins prepared from young rabbit and human (still-born baby) lenses reveals the presence of three distinctly separable components, α , β and γ . The α and β crystallines obtained from soluble fractions of rabbit and human lenses by isoelectric precipitation at pH 5.0, when subjected to electrophoresis, do not show the presence of any other component. At very old age, only the concentration of β crystalline is affected, e.g., the soluble fractions obtained from old rabbit lens and from senile cataract do not show the

TABLE I

The variations in the pattern of free amino-acids in rabbit and human lens comparing with human senile cataract

Rabbit			
Eight days old	One month old	Three months old	Adult
Aspartic acid	Aspartic acid	Aspartic acid	..
Cysteine	Cysteine	..	..
Lysine	Lysine	..	..
Alanine	Alanine	..	..
Leucine	Leucine	..	..
Isoleucine	..	..	..
Gluconine	..	..	..

Human			
Still-born baby	Adult	Old	Cataract
Aspartic acid,	..	..	..
Cysteine	..	..	..
Glycine	..	..	..
Alanine	..	..	..
Leucine	Leucine	..	..
..	Glutamic acid	..	..
..
..

presence β crystalline more than 25-30%. There is also some decrease in the concentration of α component. The electrophoretic analysis was carried out on paper strips (Whatman No. 3) in a medium containing veronal buffer, pH 8.6 and ionic strength 0.05 at constant voltage of 220. It is thus apparent from the results that a complete disappearance of free amino-acids from lenses of old rabbits and senile cataracts and an appreciable decrease (70-75%) in β crystalline concentration in the soluble fractions of these lenses occur. The quantitative estimation of α and β crystalline was obtained by densitometer.

In normal lens, the denatured protein that accumulates with age is being continuously degraded and replaced by newly synthesised proteins for the maintenance of transparency of the lens at normal level. Since the number of amino-acids in the pool decreases with age, it is understandable that protein synthesis cannot be continued to maintain the concentration of β crystalline in the soluble fraction of lens at normal level. It should be noted that a decrease of 70-75% in the concentration of β crystalline in old rabbit lens and senile cataract has been noted. It is however possible that β crystalline is converted to albuminoid thus

one can explain the relative increase in latter's concentration in old rabbit lens and senile

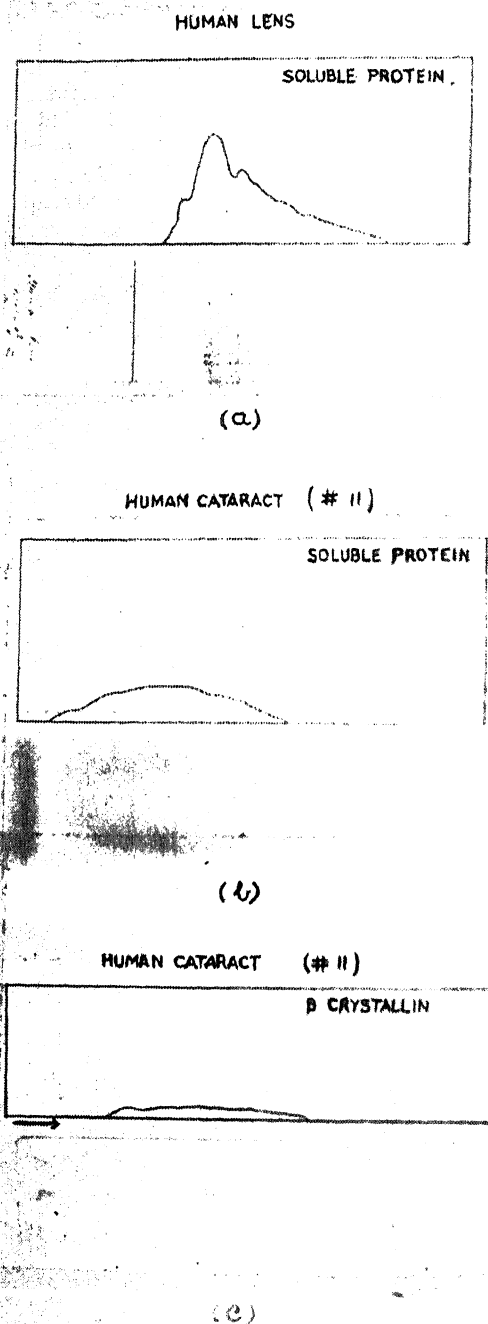


FIG. 1. Paper electrophoresis of soluble proteins of the lens and cataract. (a) normal human lens, (b) human senile cataract, (c) β crystalline from human senile cataract.

cataract. Its accumulation is possible in such lenses because of the loss of neutral proteinase.^{4,5} It should be recalled that this neutral proteinase in the normal lens removes this protein by degradation.⁶ It is not however clearly understood whether or not these changes are the end results of some basic biochemical changes in the lens that initiate the development of cataract or should they be considered as the cause of its formation.

Dept. of Biochemistry, ANIMA DEVI.
Punjab Agricultural Univ., PIARE LAL RAINA.*
Ludhiana, Punjab,† March 19, 1965.

* Present address : University of Sydney, Sydney, Australia.

† Part of the work has been carried out in the Department of Biochemistry, Post-Graduate Institute for Medical Research, Chandigarh, Punjab.

1. Piare, A. and Van Heyningen, R., *Biochemistry of the Eye*, 1956, p. 93.
2. Jess, A., *Arch. Ophthalm.*, 1913, **42**, 45.
3. Dische, Z., Elliot, J., Pearson, E. and Merriam, G. R. J., *Am. J. Ophthalm.*, 1959, **47** (1), Part II, 368.
4. Zeller, A. and Devi, A., *Ibid.*, 1957, **44** (5), Part II, 281.
5. Devi, A., *Biochem. et Biophys. Acta*, 1963, **73**, 155.
6. —, *Am. J. Ophthalm.*, 1961, **51** (5), Part II, 1004/132.
7. — and Raina, P. L., Communicated to *Ind. J. of Medicine*, 1965.

SPECTROCHEMICAL ANALYSIS OF TRACE CONSTITUENTS IN URINARY CALCULI

CERTAIN samples of Kidney Stones (Urinary Calculi) extracted from individuals belonging to either sex were spectroscopically examined. The emission spectrographic techniques adopted for this examination revealed interesting results. The sterilized sample ground into a fine powder was mixed with an equal amount of specpure carbon powder and was excited in the anode of a 220 V D.C. arc. The current in the arc was varied from 2 to 6 amps. The spectra were recorded in the wavelength region λ 6500- λ 2000 Å on Ilford Special Rapid and Ilford Panchromatic Plates using Hilger large Quartz and Glass spectrographs. In all these samples, we found calcium and magnesium as major constituents and phosphorus, iron, copper and sodium as minor constituents. Lead and tin are also found to be present in certain individuals. Two important and interesting results of this work are the non-detection of silicon in all the samples and of tin in the sample extracted from a woman. The non-detection

means that the concentration of these elements are either below their detection limits (Si : 20 p.p.m., Sn : 10 p.p.m.¹) or are totally absent. It is of interest to note in this connection that the human blood contains 0.5 mg. of silicon per 100 c.c. and trace elements like Si, Fe, Cu, Mg, and P are detected in the urine.² In some animals silicon is deposited in granules in kidney, bladder or uterua to form stones (Underwood). The non-detection of silicon in the present investigations only means that this element does not play an important role in the formation of the stones in human beings. The variation of these elements from individual to individual is a matter for further investigation. These investigations would facilitate us to understand the root cause for the formation of these stones in the kidneys.

Department of Physics, S. V. J. LAKSHMAN.
S.V. University, Tirupati, K. SRIHARI RAO.*
August 31, 1965.

* Andhra Medical College, Visakhapatnam.

1. Ahrens, L. H. and Taylor, S. R., *Spectrochemical Analysis*.
2. Underwood, U. J., *Trace Elements in Human and Animal Nutrition*.

RELAXATION TIMES AND 'AVERAGED MUTUAL VISCOSITIES' OF THREE SUBSTITUTED BENZENES

IN continuation of our work¹ on the dependence of dielectric relaxation times on the 'averaged mutual viscosities' between the solute and the solvent, the authors have reported in this note the 'averaged mutual viscosities' of benzaldehyde, *ortho*- and *meta*-chlorobenzaldehyde in benzene at 30° C. The viscosity measurements were carried out by means of Hoppler's precision viscometer (Germany). The relaxation times of the substituted benzenes were determined by the dilute solution method employing 3 cm. standing wave technique.² The overall accuracy of the viscosity measurements and the relaxation time determination was $\pm 2\%$ and $\pm 10\%$ respectively.

Relaxation times and the 'averaged mutual viscosities' of benzaldehyde and of *ortho*- and *meta*-chlorobenzaldehyde are given in Table I. It may be observed from Table I that the 'averaged mutual viscosity' increases from *ortho*- to *meta*-chlorobenzaldehyde. This explains the relative increase in relaxation times from *ortho*- to *meta*-chlorobenzaldehyde since the 'averaged mutual viscosity' is directly proportional to the relaxation time for the same molecular size.³ However, it could be seen that on calculating

TABLE I
Relaxation times and averaged mutual viscosities of disubstituted benzenes
Temperature 30° C. Viscosity of benzene, $\eta_B = 0.593$ cp.

Substance	Solvent	$\tau \times 10^{12}$ (sec.)	η_{AB}	$\frac{\tau}{\eta_B} \times 10^{10}$	$\frac{\tau}{\eta_{AB}} \times 10^{10}$
Benzaldehyde	.. Benzene	9.5	0.89	15.85	10.69
<i>o</i> -Chlorobenzaldehyde	.. Benzene	12.6	0.85	21.24	14.82
<i>m</i> -Chlorobenzaldehyde	.. Benzene	16.1	1.06	27.11	15.10

the relaxation time by replacing the 'solvent viscosity' by 'the averaged mutual viscosity' in the Debye Equation, the calculated values are considerably higher than the experimental values. The concept of averaged mutual viscosity is also limited due to the fact that it cannot be evaluated for solid substances dissolved in non-polar substances.

Physics Department, K. C. LAL.
Lucknow University, H. N. SRIVASTAVA.*
Lucknow, September 14, 1965.

* Present address : Meteorological Office, Bangalore.

1. Srivastava, H. N., Lal, K. C. and Sharma, M. N., *J. Phys. Chem. (U.S.A.)*, 1962, **66**, 1739.
2. —, *J. Sci. industr. Res.*, 1962, **21 B**, 366.
3. Hill, N. E., *Proc. Phys. Soc. Lond.*, 1954, **67 B**, 149.

PREPARATION OF IODINE-131 LABELLED HIPPURAN FOR MEDICAL USE

IODINE-131 labelled Hippuran (Sodium ortho iodo hippurate) has been used in kidney function studies.^{1,2} The product is used in the form of a sterile isotonic solution of hippuran with a specific activity of 10–50 mc/mM and radiochemical purity not less than 95%. A number of methods have been described for the preparation of I¹³¹-Hippuran^{3–5} involving exchange between sodium ortho iodo hippurate and iodine-131 in the form of hypoiodite³ or elemental iodine⁴ or iodine monochloride.⁵ A simpler method involving exchange between Hippuran and sodium iodide-I¹³¹ in the presence of H₂O₂ has been developed in this laboratory for the preparation of pure I-131 Hippuran.

Details of the Method.—360 mg. of sodium orthoiodo hippurate dihydrate (City Chemical Corporation, New York) is dissolved in 1 millilitre of molar sodium acetate buffer pH 5. 50–100 millicuries of NaI¹³¹ (carrier free) are added, followed by 10 ml of 100 volume H₂O₂ (E. Merck, G. R. Grade), the mixture heated at 60–80° C. for 2 hours and allowed to cool. Sodium sulphite solution is added to the mixture,

followed by NaI carrier and 3–4 N HCl to precipitate the iodo-hippuric acid. The precipitate is centrifuged off, redissolved in dilute sodium hydroxide solution and reprecipitated, after adding sodium sulphite and carrier iodide. The dissolution and reprecipitation are repeated 4 times to give a radiochemically pure product, which is dissolved in isotonic glycine buffer (M. Glycine in 1 N NaOH solution—9 : 1) and the solution is sterilised by aseptic filtration.

The radiochemical purity of the product is ascertained by paper chromatography using butanol : acetic acid : water (4:1:1) and butanol : acetone : water (5 : 5 : 1) as solvents—Rf of Hippuran 0.82, 0.5 respectively, Rf of ortho iodobenzoic acid 0.92, 0.64 respectively and Rf of iodide 0.14, 0.3 respectively.

The product has been tested clinically and found suitable for kidney function studies.

Atomic Energy Estab., R. S. MANI.
Isotope Division, R. J. V. PRABAKARAN.
Trombay, Bombay, October 29, 1965.

1. Lawrence, J. H., *Radioisotopes and Radiation—Recent Advances in Medicine, Agriculture and Industry*, McGraw-Hill Book Company, New York, 1964, p. 16.
2. Thomas, P. Hyne, *J. Lab. Clin. Med.*, 1961, **58** (4), 598.
3. Tubis, M. and Posnick, E., *Proc. Soc. Exptl. Biol. Med.*, 1960, **103**, 497.
4. Milta, A. and Farga, A., *Int. J. Appl. Radiat. and Isotopes*, 1961, **12**, 146.
5. Anghileri, L. J., *Ibid.*, 1964, **15**, 95.

PRELIMINARY REPORT ON THE ISOLATION OF VIBRIO FETUS ORGANISM FROM THE FEMALE GENITAL TRACT OF BUFFALOES IN INDIA *

THE problem of infertility due to infectious agents is considered to be of significant nature in bovines particularly in buffaloes. The informations about the causes of sterility and abortions both in the heifers and adult buffaloes are scanty. Including some others, vibriosis is

recognised to be a specific venereal disease of cattle, buffaloes, sheep and goats causing both sterility and abortions. It is suspected that *Vibrio fetus* infection in cattle and buffaloes may be responsible for some of the undiagnosed cases of breeding troubles in this country. Some information is already available on the incidence of brucellosis for which certain control measures have been adopted. As yet there is no report of any isolation of *Vibrio fetus* organisms from India although, on the basis of limited serological reactions, there are indications of its existence (Mohan, 1954). In this investigation special efforts were made to detect the presence of *Vibrio fetus* infection on the basis of isolation of the organism.

On the basis of cultural examination of 326 female genital tracts of buffaloes, mostly from slaughter houses, three strains of *Vibrio fetus* were isolated. A heavy inoculum of the mucus from vaginal and cervical regions was streaked on 10% bovine blood agar plates containing 0.4% thiol powder and 1:40,000 concentration of brilliant green (Floret, 1956). The inoculated plates were incubated in an atmosphere of 10% carbon dioxide at 37°C. and initially were examined after three days of inoculation with the help of a low power hand-lens. If there was no growth the plates were incubated for another three days and CO₂ was replaced after each successive examination. The colonies of *Vibrio fetus* on blood agar medium which were hardly visible in the beginning were shiny, semi-translucent, pale gray and punctiform. Usually only few colonies were visible and the growth was always scanty. The stained preparations of strains, isolated during the course of this study, showed typical morphology and biochemical reactions of *Vibrio fetus*. They were Gram-negative, motile, typically comma-shaped curved rods, loop forms or spirals (Fig. 1). The details of the cultural, biochemical and other reactions of *V. fetus* strains are shown in Table I which were identical in all the three strains.

The reactions shown by these strains clearly indicate about their pathogenic nature. Bryner and Frank (1955) reported that pathogenic strains are catalase-positive and H₂S-negative. Similar observations were made by Bryans and Smith (1960). This organism is very fastidious to grow and needs special precautions particularly at the time of the first isolation.

The authors believe that this report will stimulate other research workers to give more attention for the isolation of *V. fetus* organism

from cattle and buffaloes having unexplained breeding troubles.

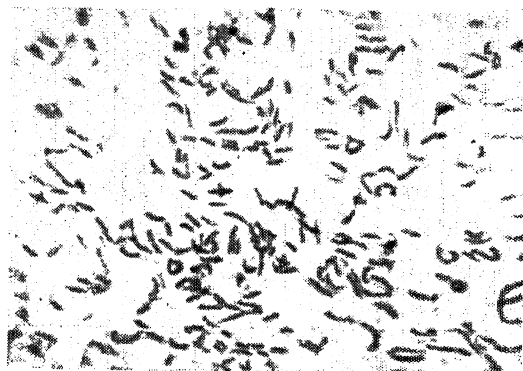


FIG. 1. Showing morphology of *Vibrio fetus* organisms, × 800.

TABLE I
The cultural, biochemical and metabolic reactions of *Vibrio fetus* strains isolated from genital tract of buffaloes

Tests	Results
Motility	+
Catalase production	+
H ₂ S Production	-
Nitrate reduction	+
Growth in thiol semi-solid agar medium	Fan-shaped and ring form about 2 to 3 mm. below the surface
Growth in deep stab	-
Growth in liquid medium	-
Growth under 10% CO ₂ tension	+
Growth under atmospheric condition	-
Growth in media containing 4% sodium chloride	-
Growth in media containing 1% oxgall	+

+ = positive reaction.

- = negative reaction.

The authors are grateful to Principal C. V. G. Choudary for providing facilities to carry out this work.

Department of Bacteriology, C. B. PRASAD.
U.P. College of Veterinary B. S. MALIK.
Science and Animal Husbandry,
Mathura (U.P.), July 23, 1965.

* A portion of the thesis submitted by Sri. C. B. Prasad to the Agra University in partial fulfilment for the degree of M.V.Sc.

1. Bryans, J. T. and Smith, A. G., *Cornell. Vet.*, 1960, 50, 331.
2. Bryner, J. H. and Frank, A. H., *Am. J. Vet. Res.*, 1955, 16, 76.
3. Floret, A., *C.R. Soc. Biol.*, 1956, 150, 1059.
4. Mohan, R. N., *Ind. J. Vet. Sci.*, 1954, 24, 173.

**OVIPARITY IN SUGARCANE APHID—
LONGIUNGUIS SACCHARI ZLMT.
(APHIDAE: HOMOPTERA)**

INDIAN aphids in the past have been commonly considered viviparous in their mode of reproduction and there appears to be no previous record of their oviparity in this country. While studying the biology of the pink sugarcane mealybug on the sprouting sugarcane stems in the laboratory, some females of the sugarcane aphid were allowed to feed on the very young seedlings of the same cane stems. The vigorously growing colonies of these aphids were examined daily for the peculiar head-nodding of the feeding insects only for the sake of interest. One day one female came under observation laying an egg. But after laying one egg she resumed her normal course of viviparity. In the successive days three or four females were again observed behaving like the one described above. But in all the cases oviparity was just an irregularity in the normal course of viviparity.

The egg measures $442.42-561.5 \mu$ (av. 510.8μ) in length and $198.18-231.2 \mu$ (av. 220.2μ) in width (across the middle) and is simple and oval in shape with round ends (Fig. 1). The

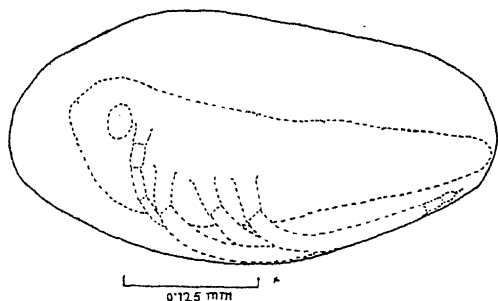


FIG. 1. Fully developed newly laid egg—the miniature nymph is clearly visible inside the thin transparent egg-case.

egg-case is thin and transparent. The fully formed miniature nymph, inside the egg-case, is visible when examined under a binocular microscope (Fig. 1). The nymphal movements can be seen distinctly before hatching. The egg hatches soon after its laying. In one instance an egg-case was found attached to the hind leg of the just-born nymph (Fig. 2). Thus the so-called viviparity in aphids seems due to the overdue retention of the egg in the vaginal tube during the process of egg-laying.

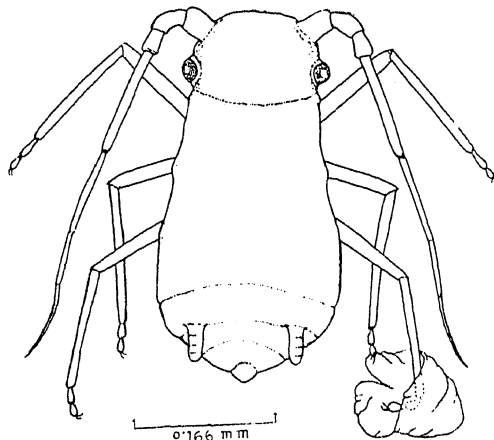


FIG. 2. Just-born nymph with the egg-case attached to its hind leg.

I am thankful to Dr. B. S. Chandel for his guidance, and to the C.S.I.R., New Delhi, for a Junior Fellowship.

Department of Zoology,
B.R. College, Agra,
July 2, 1965.

R. L. YADAVA.

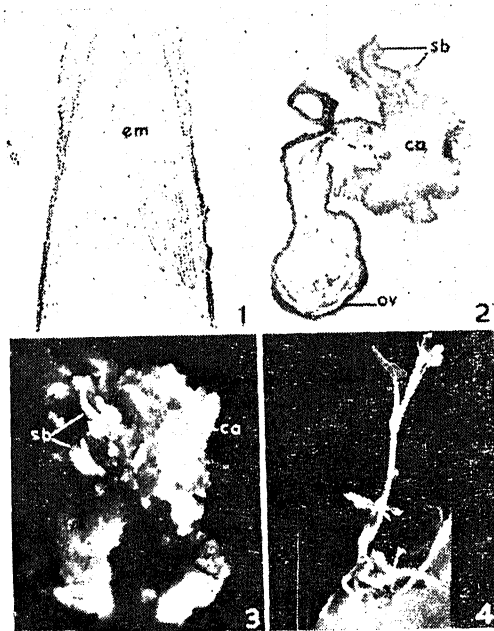
**MULTIPLE SHOOT FORMATION FROM
THE EMBRYONAL MASS OF
FAGOPYRUM SAGITTATUM GILIB.**

In a *Vanda* hybrid Rao¹ obtained an embryo callus which later differentiated and formed seedlings. When the ovaries of *Foeniculum vulgare*, excised at the globular embryo stage, were cultured on modified White's medium supplemented with casein hydrolysate alone or used in combination with yeast extract, there was a proliferation of the embryo and this proliferated mass of tissue produced accessory embryos within three weeks. These in turn produced multiple shoots.²

The present communication deals with some observations on cultured ovules of *Fagopyrum sagittatum* containing immature embryos. The material was collected from the Botanical Garden of the University of Delhi. The ovaries were surface sterilised with chlorine water, and ovules containing a cellular endosperm and an immature dicotyledonous embryo (Fig. 1) were inoculated under aseptic conditions on a modified White's basal medium³ containing only 2% sucrose and fortified with 2, 4-D (5 ppm) + yeast extract (2,500 ppm). The cultures were maintained under diffuse light at $25 \pm 2^\circ \text{C}$ and 50-60% R.H.

One week after inoculation the ovules burst at the micropylar end. The radicle grew out

and proliferated. The tip callused very rapidly. After two weeks there arose several shoot-like structures (Fig. 2). Later the whole structure became spongy and within six weeks showed a differentiation of additional shoot-buds (Fig. 3). These were isolated and transferred to a fresh medium after which they produced still another crop of shoot-buds. This process could be repeated indefinitely. When the isolated shoot-buds were transferred to the basal medium supplemented with coconut milk (10%) and containing 4% sucrose they differentiated into normal seedlings bearing a well-developed root and shoot system and green leaves (Fig. 4).



FIGS. 1-4. Fig. 1. L.s. of ovule at inoculation stage showing young embryo, $\times 46$. Fig. 2. L.s. of ovule after 2 weeks of culturing on WB+2,4-D (5 ppm) + yeast extract (2,500 ppm); note a callusing mass with differentiating shoot-buds, $\times 11$. Fig. 3. 6-week-old culture on WB + 2,4-D (5 ppm) + yeast extract (2,500 ppm); note a number of shoot-buds from the callus mass, $\times 1.3$. Fig. 4. 10-week-old seedling obtained after transferring the shoot-buds on WB+coconut milk (10%), $\times 5$. (ca, callus; sb, shoot-buds, em, embryo; cv, ovule.)

These observations suggest that immature embryos of *F. sagittatum* cultured on a suitable medium have the capacity to produce unlimited tissue masses capable of forming shoot-buds. Thus, it is possible to obtain from a single embryo a large population of seedlings possessing the same characters without undergoing a long sexual process.

I wish to express my grateful thanks to Prof. P. Maheshwari and Prof. B. M. Johri for their keen interest and valuable suggestions throughout the present investigation. Acknowledgement is also made to the University Grants Commission, New Delhi, for financial assistance.

Department of Botany,
University of Delhi,
Delhi 7, India, May 31, 1965.

M. ZENKTELER.*

* Senior Research Fellow of the University Grants Commission, New Delhi. Present address: Department of General Botany, University of Adam Mickiewicz, Poznan, Poland.

1. Rao, A. N., *Plant Tissue and Organ Culture—A Symposium*, Internat. Soc. Plant Morphol., Delhi, Eds. P. Maheshwari and N. S. Rangaswamy, 1963, p. 421.
2. Sehgal, C. B., *Curr. Sci.*, 1964, **33** (12), 373.
3. Rangaswamy, N. S., *Phytomorphology*, 1961, **11**, 109.

A NOTE ON THE KARYOMORPHOLOGY OF *LIMNOPHYTON OBTUSIFOLIUM* MIQ.

Limnophyton obtusifolium Miq. is a member of Alismataceae and is the only species recorded in Deccan and South India (Hooker, 1894; Gamble, 1928). It is an erect succulent marshy herb common in all districts. There is no earlier record of work on the cytology of this species except a reference to its chromosome number by Murthy (1933) in connection with his embryological study on this plant. Murthy recorded the chromosome number in *Limnophyton obtusifolium* Miq., as $2n = 24$ ($n = 12$). This number does not, however, fit in properly with the basic number in other genera like *Alisma*— $n = 5, 6, 7, 13$; *Baldellia*— $n = 7, 8, 9$; *Echinodorus*— $n = 11$; *Sagittaria*— $n = 11$ (Darlington and Wylie, 1955). The present investigation was undertaken to find out the correct chromosome number of the plant and thus clarify the real karyotype situation.

The material was collected from the Savandurga Hills region about 35 miles from Bangalore (S. India). Excised root-tips were treated with 0.002 mol. 8-hydroxyquinoline for about 3 hours at 12°C and squashed in acetic-orcein.

The present study reveals that the somatic chromosome number in this species is $2n = 22$ ($n = 11$) which fits in well with the basic chromosome number of the genera like *Echinodorus* and *Sagittaria*. Figure 1 is a somatic metaphase configuration showing the twenty-two chromosomes and Fig. 2 is the corresponding idiogram.

A striking feature of this karyotype is the presence of subterminal primary constrictions in all chromosomes with the exception of only one pair which is the longest and with median primary constrictions. An additional significant feature is that except for the longest pair there



FIG. 1. Somatic metaphase, $\times 1,500$.



FIG. 2. Idiogram of the somatic haploid complement, $\times 1,500$.

is no appreciable difference in the relative length of the chromosomes of the complement. In poor preparations it is possible that the two longest chromosomes with median constrictions could be mistakenly interpreted as four chromosomes. Such an error would possibly lead to the counting of the number as twenty-four, the number reported by Murthy.

The authors gratefully acknowledge the helpful suggestions of Dr. K. V. Srinath during the course of this investigation.

Department of Botany,
Bangalore University,
Central College, Bangalore, June 29, 1965.

A. SHERIFF.
M. NAGARAJ.

1. Hooker, J. D., *Flora of British India*, 1894.
2. Gamble, J. S., *Flora of the Presidency of Madras*, 1928.
3. Murthy, S. K. N., *J. Mysore Univ.*, 1933, 7, 1.
4. Darlington, C. D. and Wylie, A. P., *Chromosome Atlas of Flowering Plants*, London, 1955.

MANNURONIC ACID IN THE CELL-WALL OF *RICCARDIA*, A JUNGERMANNIALEAN LIVERWORT

It has previously been reported¹ from this laboratory that mannuronic acid is one of the principal organic acids found in some liverworts including *Riccardia*. This finding was highly interesting in as much as mannuronic acid was hitherto known to be a constituent of alginic acid restricted to the cell-wall of brown algae.² The present investigation was attempted to find out whether in liverworts also mannuronic acid enters into the constitution of cell-wall polysaccharides.

Cell-walls of the gametophyte of *Riccardia levieri* were prepared according to the technique of Ray³ who used it to obtain the walls of oat coleoptilar cells. The dried wall preparation was extracted with 0.5% ammonium oxalate for four hours at 100°C. Ammonium oxalate soluble fraction was hydrolysed with 1.0 N sulphuric acid in a sealed tube for 30 minutes under pressure. The hydrolysate was neutralised with barium hydroxide, centrifuged, concentrated and was subjected to paper chromatographic analysis.

Chromatograms when sprayed with aniline phthalate or with *p*-anisidine hydrochloride revealed the occurrence of a prominent spot of uronic acid besides galactose and arabinose. The characteristics of uronic acid component in two different solvents are given in Table I.

In both the solvents the uronic acid had identical behaviour with the authentic sample of mannuronic acid. Additional confirmation was provided by elution of the spot from unsprayed sheet and by cochromatography. Also in ethyl acetate solvent mannuronic acid gave rise to a characteristically elongated spot which agreed exactly with the unknown while glucuronic acid exhibited a discrete heart-shaped spot. The movement of galacturonic acid was distinctly slower in both the solvents. Therefore the identity of uronic acid of cell-wall

TABLE I

Chromatographic behaviour of the unknown
and the authentic uronic acids

*Distance (cm.) migrated from starting line in		
	†Ethyl acetate/ pyridine/acetic acid/H ₂ O (5 : 5 : 1 : 3)	‡n-butanol/ acetic acid/ H ₂ O (2 : 1 : 1)
Unknown ..	18.20	16.90
Galacturonic acid ..	12.80	14.00
Glucuronic acid ..	17.00	16.40
Mannuronic acid ..	18.50	17.00

* Descending direction on Whatman No. 1 paper for 18 hours at 28°C. † Block, Durrum and Zweig (ref. 4). ‡ Hirst (ref. 5).

of *Riccardia* with mannuronic acid is taken to be established. This observation seems to bring liverworts closer to Phaeophyceae where alginic acid usually occurs⁶ than to green algae from the standpoint of comparative cell-wall chemistry. Detailed analysis of other fractions of the cell-wall of *Riccardia* is under progress.

This investigation was supported by a grant-in-aid from the Council of Scientific and Industrial Research.

Department of Botany,
S.V. University,
Tirupati (A.P.), July 21, 1965.

V. S. R. DAS.
M. P. RAO.

1. Das, V. S. R. and Rao, M. P., *Nature*, 1963, **198**, 970.
2. Bell, D. J., in *Comparative Biochemistry*, Academic Press, New York, 1962, **3**, 287.
3. Ray, P. M., *Biochem. J.*, 1963, **89**, 144.
4. Block, R. J., Durrum, E. L. and Zweig, G., *A Manual of Paper Chromatography and Paper Electrophoresis*, Academic Press, New York, 1958.
5. Hirst, E. L., in *Modern Methods of Plant Analysis*, Springer Verlag, 1955, **2**, 275.
6. Frei, E. and Preston, R. D., *Nature*, 1962, **196**, 130.

THE RADIOSENSITIZING EFFECTS OF N-ETHYLMALAMIDE ON *VICIA FABA*

THE radiosensitizing action of N-Ethylmaleimide was first shown by Bridges¹ in *Escherichia coli*. The present report summarizes the results of a study designed to check the sensitizing ability of N-Ethylmaleimide using the frequency of chromosome and chromatid aberrations in roots of *Vicia faba* (Var. Weibull's Åkerbona) as the radiation effect. The seeds were germinated in sand beds and the primary root-tips were cut off when they were 1 cm. in length. The seedlings were then allowed

to develop secondary roots, in glass vials containing tap-water at $25 \pm 1^\circ \text{C}$. The secondary roots were treated for 24 hours with aqueous $10 \mu\text{M}$ solution of N-Ethylmaleimide in phosphate buffer at pH 7. The concentration used is the maximum non-toxic dose and was selected after considerable trial. The chemically treated seedlings were divided into two sets. One set was kept in double distilled water for 24 hours and the second set was given 50 R of X-rays (Phillips X-ray equipment operated at 50 KV with 2 mm. Al filter) at the dose rate of 25 R/minute. Another set of non-chemically treated seedlings was irradiated with 50 R of X-rays, to serve as control for the chemical-radiation combination treatment. After 24 hours of recovery period the roots were pretreated with 0.05% colchicine, washed in water and fixed in acetic alcohol (1:3). Slides were prepared as feulgen squashes and scored for chromatid gaps (G'), chromosome gaps (G''), chromatid breaks (B'), chromosome breaks (B'') and also for both chromatid as well as chromosomal exchanges. The data are given in Table I. It is evident from the data that N-Ethylmaleimide is a poor chromosome-breaking agent, but when it is followed by radiation, there is a significant enhancement in the yield of chromosomal aberrations. The total number of chromosomal aberrations obtained in the combination treatment of chemical and radiation (27.24%) is more than additive of the aberrations produced separately by chemical (2.22%) and radiation (11.05%).

There is no other report except that of Bridges¹ about the sensitizing action of such a group of compounds, although halogen acetates which combine with sulphydryl groups in similar way as ethylmaleimide, have been reported to act as sensitizing agents for mammals.^{2,3}

The property of N-Ethylmaleimide to combine and inhibit the sulphydryl groups, which are known to be the radio-protective agents,⁴ may be responsible for its radiosensitizing ability. N-Ethylmaleimide in spite of its sensitizing action has proved itself very toxic to *Vicia faba*. Bridges¹ in his experiment with *E. coli* has applied the dose as high as 0.001M , whereas *Vicia faba* roots were unable to withstand even 1 hr. treatment of as low a concentration as $20 \mu\text{M}$.

A similar type of study is in progress with *Drosophila*.⁵ The preliminary results obtained from this study support the radiosensitizing property of N-Ethylmaleimide,

TABLE I

Treatment	Chemical dose	Radiation dose	Recovery time	No. of cells analysed	No. of abnormal cells	Types of aberrations				Exchanges		Total No. of aberrations
						G'	G''	B'	B''	Chromatid	Chromosome	
X-rays control	.. -	50 r	24 hrs.	380	38	2	4	12	14	8	2	42
N-Ethylmaleimide	.. 10 μ M	-	24 hrs.	225	5	0.52	1.04	3.15	3.68	2.10	0.52	11.05
					2.22	-	0.88	0.44	0.88	-	-	2.22
N-Ethylmaleimide + X-rays	.. 10 μ M	50 r	24 hrs.	345	83	3	6	12	48	18	7	94
					24.05	0.86	1.72	3.48	13.91	5.21	2.02	27.24

I wish to thank Dr. M. S. Swaminathan for his interest and Dr. S. Bhaskaran for the supply of chemical used in this study.

Division of Botany, R. P. SHARMA.
Indian Agri. Res. Inst.,
New Delhi, July 23, 1965.

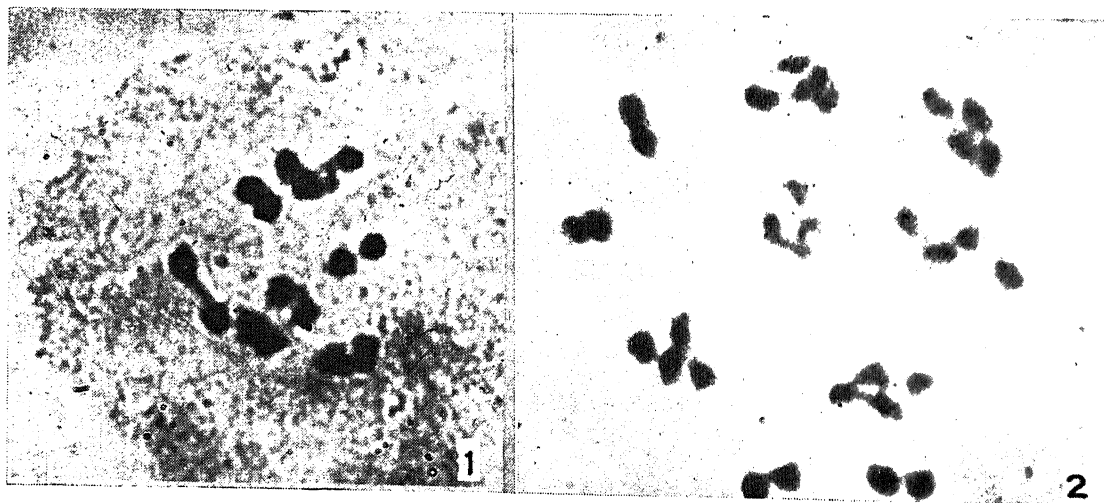
1. Bridges, C. B., *Nature*, 1960, **188**, 415.
2. Feinstein, R. N., *Amer. J. Physiol.*, 1954, **177**, 156.
3. Quintiliani, M. and Boccacci, M. R. C., *1st Sup. Scinta*, 1960, **23**, 1.
4. Chopra V. L., Kapoor, M. L. and Swaminathan, M. S., *Ind. Jour. Exp. Bio. C.S.I.R., India* (In press).
5. Sharma, R. P. and Swaminathan, M. S. (Unpublished).

INDUCED POLYPLOIDY IN METHRA

METHRA OR METHA (*Trifolium faenum-graecum* Linn.) is a highly palatable and nutritious leguminous rabi fodder of low irrigational requirements, yielding about 200 to 250 quintals per hectare of green matter. It is grown under a variety of soil and climatic conditions all

over India. It is very commonly raised as a catch crop after paddy and cotton. It has a somatic chromosome number 16.

Fodder crops have figured prominently among the few available examples of economically useful varieties resulting from induced autopolyploidy. Red clover (*Trifolium pratense* L.), alsike clover (*T. hybridum* L.) have been released for general cultivation in Scandinavian countries.¹ Pusa giant berseem, the first colchicine-induced tetraploid has been very recently released for cultivation in India.² Work was hence taken up at the Indian Agricultural Research Institute on the induction of polyploidy in *methra* during 1963. Week old seedlings of three different strains, viz., E.C. 4911 (exotic), I.C. 5687 and local (indigenous) were treated with colchicine in two ways: (a) complete immersion of seedlings in 0.05 to 0.1% colchicine solution for 4, 8 and 12 hours at room temperature, and (b) treating the apical buds only with 0.1 to 0.2% colchicine for 3, 6 and 9 hours for one to three consecutive days



FIGS. 1-2. Fig. 1. P.M.C. meiosis showing 8_{II} at M. I. (Diploid *methra*, 2n=16). Fig. 2. P.M.C. meiosis showing 5_{IV} + 1_{III} + 4_{II} + 1_I at M.I. (Tetraploid *methra*, 2n=32).

by placing cotton wads in between the newly opened cotyledons of the seedlings in nursery beds. The technique which gave the highest percentage of tetraploids was the apical bud treatment with cotton wads, saturated with 0.2% colchicine for 6 and 9 hours for two consecutive days. The following is the summary of observations on C_1 and C_2 generations.

The tetraploid plants, in general, showed a greater and quicker growth and vigour in addition to the characteristic features usually associated with chromosome doubling such as increase in size of cells, stomata, pollen and seed and reduction in pollen and seed fertility. As compared to the diploid parents the tetraploids had thicker but softer and more succulent stems, broader, thicker, darker green and more succulent leaves with lower leaflet index, larger floral parts and flowers, bigger seeds but smaller pods. The tetraploids were late by 3-4 weeks in respect of flowering and maturity. The preliminary observations made from the C_2 generation revealed (a) the different strains differed in their response to polyploidy and had a much wider range of variation in respect of almost all the morphological characteristics, (b) there were many tetraploid plants showing double the number of branches and 2-3 times forage yield as compared to the corresponding diploids, (c) the tetraploids seemed to have higher essential oil content, (d) the tetraploid fruiting pods were significantly smaller than those of the diploids, (e) the seed set in the tetraploids ranged for 0.00 to 4.0 per pod against 9.0 to 17.00 seeds per pod in the diploids.

The meiotic behaviour in the sporocytes of the parental diploids was normal forming 8 bivalents at meiosis (Fig. 1). In the case of the tetraploids, however, a maximum of 6 quadrivalents per cell was encountered (Fig. 2) with a mean frequency of $IV_{3.84}$, $III_{1.63}$, $II_{5.60}$ and $I_{1.63}$ at Metaphase I.

From the results so far obtained, the outlook for evolving tetraploid strains of *methra*, superior in forage yield and essential oil content to the diploid variety, is hopeful. The improvement of seed fertility and the selection of cultures with a good fodder yield as well as a high percentage of dry-matter content would be the chief problems for breeding *methra* at tetraploid level.

Division of Botany,
Indian Agricultural
Research Institute,
New Delhi, June 21, 1965.

R. K. MEHTA.
AMAR SINGH.
RANJIT GHOSH.

1. Akerberg, E., Bingefors, S., Josefsson, A. and Ellerstiöm, S., *Induced Polyplids as Forage Crops*. Svalof, 1946-61, Recent Plant Breeding Research, Almquist and Wiksell, Stockholm, 1963.
2. Mehta, R. K. and Swaminathan, M. S., "Pusa Giant Berseem—the first colchicine-induced tetraploid released for cultivation in India," *Ind. Fmg.*, 1965, 15 (6), 4-5.

CLONAL PROPAGATION OF MANGO THROUGH CUTTINGS

MUKHERJEE, Majumder, Bid and Goswami report (*Curr. Sci.*, 1965, 34, 434): "In a recent report to the International Horticultural Congress, Oppenheimer, has indicated that rooting of cuttings from mature mango trees could not be made a success so far by any worker."

Allow me to say that a painstaking search through my paper has failed to show where I could have made such a statement. The only possible source of the misunderstanding may be the following:

"Q: Have you in fact found freely rooting types among your mangoes and avocados for the production of clonal rootstocks?"

R: 1. No mango cuttings have been tried, only polyembryony used."

This meant very obviously that *we had not tried* to root mango cuttings. It could neither mean that nobody else had tried nor that nobody else had succeeded.

I tried to show that it was horticulturally unnecessary to try to establish mango clones by rooting of cuttings as the same can be done so much easier by the use of polyembryonic types.

It may be worthwhile to get clonal material from rooted mango cuttings for research purposes but their horticultural use seems to me to depend on the proof that the clones in question are clearly superior.

In avocado we have found that some clones root easily between 90 and 100% but this in itself has not much practical significance.

Clearly in avocado (and probably also in mango) selection will have to be carried out with the double aim to find clones which are both valuable as rootstocks and easy to root.

Division of Subtropical Horticulture,
Volcani Institute of
Agricultural Research,
Rehovot, Israel, November 1, 1965.
C. OPPENHEIMER.

 REVIEWS AND NOTICES OF BOOKS

Cells and Tissues in Culture—Methods, Biology and Physiology. Edited by E. N. Willmer. (Academic Press, New York and London), 1965.

Volume 1, Pp. xiv + 788. Price 168 sh.

Volume 2, Pp. xvi + 809. Price 168 sh.

Tissue Culture is being used in a wide variety of ways and in many branches of biology. The aim of this three-volume multi-author work is to assess what has been achieved so far and to discuss where, when and how the technique may be most profitably employed.

The first volume under review covers many of the more general fields of Tissue Culture, including such topics as the evaluation of the methods as such, the study of metabolic processes and growth, the action of hormones and vitamins and the use of the method in genetics. The articles and their respective authors contained in this volume are as follows: Introduction, by E. N. Willmer; Methods, by A. Moscona, O. A. Trowell and E. N. Willmer; Construction and Use of Synthetic Media, by Charity Waymouth; Morphological Problems of Cell Type, Shape and Identification, by E. N. Willmer; The Locomotory Behaviour of Cells, by M. Abercrombie; Cell Division, by H. Firket; Carbohydrate and Energy Metabolism, by John Paul; Amino-Acid and Protein Metabolism, Part I, by Harry Eagle and Leon Levintow; Amino-Acid and Protein Metabolism, Part II, by J. A. Lucy; Deoxyribonucleic Acid and Ribonucleic Acid Synthesis in Cell Cultures, by J. Seed; Mucopolysaccharide Metabolism in Tissue Culture, by J. T. Dingle and M. Webb; Genetic Cytology, by T. S. Hsu; Differentiation: Environmental Factors, Chemical and Cellular, by Clifford Grobstein; Recombination of Dissociated Cells and the Development of Cell Aggregates, by A. A. Moscona; Embryogenesis *in vitro*, by Etienne Wolff; The Action of Hormones on Cell and Organ Cultures, by Ilse Lasnitzki; The Effects of Vitamins A and C on Cells and Tissues in Culture, by Honor B. Fell and L. M. Rinaldini.

The second volume under review is devoted to studies of certain particular tissues or systems which have either been extensively investigated in themselves or which, for one reason or another, accentuate some achievement or contribution which the method has made to biology.

The articles and their respective authors contained in this volume are as follows: Macrophages, by F. Jacoby; Lymphocytes, by O. A. Trowell; Bone Marrow in Culture, by L. G. Lajtha; Cartilage and Bone, by J. D. Biggers; The Osteoclast, by Norman M. Hancox; The Development of Tooth Germs in Tissue Culture, by Shirley Glasstone; Adipose Tissue, by Richard L. Sidman; Muscle, by Margaret R. Murray; Nervous Tissues *in vitro*, by Margaret R. Murray; Special Cytology of the Eye, by D. R. Lucas; The Ear, by I. Friedmann; Skin, by C. N. D. Cruickshank; Respiratory Tract, by Margaret B. Aydelotte; Salivary Glands, Intestinal Tract, Pancreas, by Borghese; Liver, by Frederik B. Bang and Anne C. Warwick; Endocrine Glands, by P. J. Gaillard and A. Schaberg; Germ Cells and Gonads, by Etienne Wolff and Katy Haffen.

C. V. R.

Metabolism of Steroid Hormones. By R. I. Dorfman and F. Ungar. (Academic Press, New York and London), 1965. Pp. viii + 716. Price \$ 32.00.

A qualitative treatment of steroid metabolism, the aim of this work is to illustrate and tabulate the diverse aspects of steroid metabolism by presenting a compilation of a series of isolated observations. Critical evaluations and theoretical considerations have been added where appropriate. Included in discussions of the tissue hormones and metabolites studies of both *in vivo* and *in vitro* experiments comprising information obtained from many species of animals.

The articles contained in this volume are as follows: 1. Introduction; 2. Steroids Isolated from Natural Sources; 3. Biosynthesis of Steroid Hormones; 4. Steroid Transformations by Micro-organisms; 5. Catabolic Reactions of the Steroids; 6. Enzymes and Mechanisms of Reactions; 7. A System of Steroid Metabolism; 8. Relationships between Tissue Steroids and Metabolites in Blood and Urine; 9. Steroid Hormone Production Rates.

The volume also contains many structural formulæ as well as a detailed treatment of the nomenclature; this extensive documentation will be of use to the clinician, the internist, endocrinologist, gynecologist, obstetrician, pediatrician, psychiatrist, urologist, or general practitioner

who may desire a firm background in steriod biochemistry.

C. V. R.

Elements of Abstract Harmonic Analysis. By George Bachman. (*Academic Paperbacks in Mathematics*—Edited by W. Magnus and A. Shenitzer). (Academic Press, New York and London), 1964. Pp. vi + 256. Price: \$ 3.45; Clothbound \$ 6.50.

Abstract Harmonic Analysis is an active branch of modern analysis which is increasing in importance as a standard course for the beginning graduate student. This volume, in highly compact format, succeeds in covering virtually every important feature of the study while presenting the material at an introductory level throughout. To make the survey simple and self-contained, the author has wherever possible defined concepts and given proofs in great detail.

C. V. R.

Point Set Topology (Vol. XVI)—Pure and Applied Mathematics. Edited by P. A. Smith and S. Eilenberg. Author: Steven A. Gaal. (Academic Press, New York and London), 1964. Pp. xi + 317. Price \$ 9.75.

This book for beginning graduate and advanced undergraduate mathematics students presents point set topology not only as an end in itself, but also as a related discipline to the proper understanding of various branches of analysis and geometry. It starts with the basic concepts of set theory and topological spaces and ends with the beginning of functional analysis. The text and nearly all of the exercises presuppose knowledge of only those concepts defined herein, so that the book is self-contained to accommodate those who wish to study topology on their own.

The titles of the chapters contained in this volume are as follows: Introduction to Set Theory; Topological Spaces; Separation Properties; Compactness and Uniformization; Continuity; Theory of Convergence.

C. V. R.

Computer Programming—A Mixed Language Approach. By Marvin L. Stein and William D. Munro. (Academic Press, New York and London), 1964. Pp. xiv + 459. Price \$ 11.50.

This volume will be found very useful for treating all aspects of modern programming languages while explaining to the student how these are treated by the computer.

The book is designed to give a thorough foundation in computer programming techniques.

It is suitable for use as foundation material for those who are planning to become professional programmers as well as for those who will use the computer as an auxiliary tool in their own fields. 1. It provides a basic foundation in the methods of translating a problem into a form acceptable to a modern high-speed digital computer; 2. It presents the absolute language of the computer itself as a foundation and goes on to develop the modern problem-oriented languages with admixtures of all types; and 3. It features the treatment of the mixture of various computer languages for greater efficiency in programming.

The book is appropriate for a senior undergraduate or early graduate course.

C. V. R.

Lectures on Invariant Subspaces. By Henry Helson. (Academic Press, New York and London), 1964. Pp. xi + 130. Price \$ 5.00.

This little book grew out of a series of lectures given by the author at the University of Uppsala in the spring of 1962, and again in Berkeley the following semester.

The book presents an exposition of an important part of classical function theory. It centres first on analytic functions in the unit circle using the methods and techniques of Hilbert's space, and then applies these methods to vector-valued functions: the result is new implications in vectorial function theory as well as in the theories of linear operators and statistical predictions. Graduate students and persons working with function theory, harmonic analysis, linear space, and prediction theory will find this book useful and stimulating.

C. V. R.

Microwave Scanning Antennas (Vol. 1)—Apertures. Edited by R. C. Hansen. (Academic Press, New York and London), 1964. Pp. xvii + 442. Price \$ 16.00.

This volume is the first comprehensive treatment of phased arrays and quasi-optical antennas. In addition to covering phased array techniques, it includes material on related topics of recent research interest: multiple beam arrays, time domain and synthetic apertures, and adaptive antennas.

The editor has made narrow beam antennas (either mechanically steered or electronically scanned) the focal point of this work. Many constraining equations and design tradeoffs are included in the treatment, along with practical examples.

The book is intended for engineers whose understanding of narrow beam or high resolution scanning antennas must go beyond the information available from system interfaces alone; and for undergraduate and graduate students in electronics who wish to complement their study of electromagnetics with the quantitative details of hardware applications.

C. V. R.

Theory of Excitons (Supplement 5 of *Solid State Physics: Advances in Research and Application*). Edited by Fredrick Seitz and David Turnbull. Author: Robert S. Knox. (Academic Press, New York and London), 1963. Pp. vii + 207. Price \$8.50.

In the past decade, there has been a rapid growth of interest in the exciton theory, which can be traced directly to the increasing studies made of the optical properties of solids, particularly semiconductors. This book provides a comprehensive review of present knowledge, emphasizing similarities, rather than differences, among excitons in different solids.

The titles of the chapters contained in this volume are as follows: I. Introduction; II. The Electronic Structure; III. Absorption and Dispersion of Light by Nonmetallic Solids; IV. Transport Phenomena and Related Topics; and V. Summary.

C. V. R.

Electronic Aspects of Biochemistry. Edited by Bernard Pullman. (Academic Press, New York and London), 1964. Pp. xiii + 582. Price \$20.00.

Electronic Aspects of Biochemistry is a unique collection of 33 papers by a group of outstanding investigators in the field. This book's most striking and valuable achievement is the close link it establishes between the recent, complex experimentation and the modern theoretical approach. Essential problems in which electronic factors have been proven relevant are discussed. These include, in particular, the quantum theory of biomolecules and enzyme reactions, the replication and mutation mechanisms, energy and electron transfer, spectral aspects, effects of radiations, intermolecular forces, hydrogen bonding, carcinogenesis, muscle contraction, biochemical systems, role of metals, applications in pharmacology, etc. This extensive, stimulating treatise suggests new areas for future development.

C. V. R.

Modern Developments in Electron Microscopy.

Edited by Benjamin Siegel. (Academic Press, New York and London), 1964. Pp. xiii + 432. Price \$13.50.

This volume brings together a coherent group of original contributions on the applications of the electron microscope in the many fields in which it has now become an indispensable tool. Leading authorities on the subject report on progress in this rapidly developing field, stressing areas in which future progress is likely to occur.

The eight contributions and their respective authors contained in this volume are as follows: The Physics of the Electron Microscope, by Benjamin M. Siegel; Thin Metal Specimens, by D. W. Pashley; Particulate Materials, by Paul Kaesberg; Ultramicrotomy, by Keith R. Porter; In Physics, by D. W. Pashley; In Histology and Cytology, by Don W. Fawcett; In Bacteriology, by Edward Kallenberger and Antoinette Ryter; In Studies on Biological Macromolecules, by Cecil E. Hall.

The book will be of value to all serious research workers who wish to develop better understanding of the possibilities and limitations of the electron microscope in their own special areas of interest.

C. V. R.

Diuretics—Chemistry and Pharmacology. B. George DeStevens. (Academic Press, New York and London), 1963. Pp. xiii + 186. Price \$7.00.

This volume furnishes an authoritative appraisal of the significant developments in the chemistry and pharmacology of diuretics. The initial chapter, concerned with the physiology of the kidney and the pharmacological methods by which substances are evaluated for their diuretic effects, is so clearly and concisely developed that all those not well versed in the field will readily understand the dynamics of renal function. Subsequent chapters deal with the chemistry of these compounds and their structure-activity relationships. Much of the work on diuretics has been heretofore scattered throughout the literature. This volume treats uniformly the significant developments which are critically evaluated. It will serve as an important reference book for those actively interested in medicinal chemistry, and the relationship of chemical structure to biological activity.

C. V. R.

Radiation and Immune Mechanisms. By W. H. Taliaferro, L. G. Taliaferro and B. N. Jaroslow. (Academic Press, New York and London), 1964. Pp. xvi + 152. Price: Clothbound \$ 5.95; Paperbound \$ 3.45.

The volume under review contains the following thirteen chapters, a glossary, and 320 references complete with titles in alphabetical order by authors: 1. Immune Mechanisms; 2. Qualifications Affecting Radiation-Induced Injury; 3. Radiation-Induced Changes in the Primary Antibody Response as Related to Biochemical and Cellular Phases; 4. Radiation-Induced Changes in the Primary Antibody Response as Related to Species, Antigen Dosage, and Radiation Dose; 5. Radiation-Induced Changes in the Secondary Antibody Response; 6. Protection and Restoration of Antibody Synthesis in Irradiated Animals; 7. Innate Antibodies; 8. Radiation-Induced Injury to Specific Unresponsiveness (Immunological Tolerance); 9. Delayed Hypersensitivity; 10. Effects of Ionizing Radiation on the Cells Involved in Innate and Acquired Immunity; 11. Radiation-Induced Changes in the Course of Infection; 12. The Action of Radiomimetic Substances on Antibody Formation; and 13. Concluding Remarks.

Twenty figures with detailed legends and thirteen tables admirably highlight the text and serve to emphasize major experimental findings.

C. V. R.

Isotopes in Biology. By George Wolf. (Academic Paperbacks). (Academic Press, New York and London), 1964. Pp. x + 173. Price \$ 2.45.

There is clearly a need for a simple elementary account of the use of isotopes in biology, primarily as an introduction to this important area.

The present volume is intended to fulfil this need not only for the beginning student in biology but also for the many graduate students and scientists who may be entering this field of research. This work has been designed to serve as a supplementary source of information rather than as a definitive text-book.

C. V. R.

International Review of Connective Tissue Research (Vol. II). Edited by David A. Hall. (Academic Press, New York and London), 1964. Pp. xiii + 350. Price 93 sh.

Volume II of this well-known series contains the following seven contributions by the authors whose names are shown against each: 1. The

Precipitation of Collagen Fibers from Solution, by G. C. Wood; 2. Elastic Tissue, by John P. Apter; 3. Chemistry and Metabolism of Connective Tissue Glycosaminoglycans (Mucopolysaccharides), by Helen Muir; 4. The Physiology of the Connective Tissues of the Reproductive Tract, by R. D. Harkness; 5. Diseases of Collagen and Related Tissues, by L. E. Glynn; 6. Aging of the Collagen Fiber, by F. Verzar; and 7. Mucopolysaccharides, Collagen, and Non-fibrillar Proteins in Inflammation, by Albert Delaunay and Suzanne Bazin.

C. V. R.

Radiation, Isotopes and Bone. By F. C. McLean and A. M. Budy. (Academic Press, New York and London), 1964. Pp. xii + 216. Price: Clothbound \$ 5.95; Paperbound \$ 3.45.

This monograph describes the ever-increasing utilization by biologists of radiation and radioisotope techniques. The authors emphasize the importance of these new tools for studying living systems and the significance of their application by biologists to the new, closer association between the physical and biological sciences.

The subject-matter in the present volume is dealt with in fourteen chapters as follows: Introduction; The Histophysiology of Bones and Teeth; Bone-Seeking Elements; Detection and Measurement of Radioactivity; The Mineral of Bones and Teeth; Distribution of Radioelements in Bone; Kinetics of the Bone Mineral; Mineral Metabolism; Homeostasis in Mineral Metabolism; Application of Tracer Techniques to Bone; Radioisotopes and the Organic Portion of Bone; Effects of Radiation upon Bones; Natural Radioactivity and Radioactive Fallout; and The Pathology and Pathological Physiology.

C. V. R.

Algae and Man. Edited by Daniel F. Jackson. (Plenum Press, New York), 1964. Pp. x + 434. Price \$ 14.50.

This volume represents the Proceedings of the Advanced Study Institute *Algae and Man*, held from July 22 to August 11, 1962, at the University of Louisville, Kentucky, sponsored by the Scientific Affairs Division of NATO.

The book contains the summation of independent investigations in the field of phycology conducted by eminent workers from many nations. The Institute was held with the purpose of examining current concepts concerning the biology of algae and to discuss the effects of algae, both beneficial and detrimental, on the human organism.

Each paper reports a recent advance in the field. Developments in taxonomy, cytogenetics, culturing, physiology and ecology are discussed. The volume presents some of the most extensively documented evidence to date of the existence of algal toxins, together with clinical descriptions of the effect that these toxins may have on humans and animals. Topics concerning toxic algae, water supplies, pollution, water blooms, the possible role of algae as gas exchangers in space vehicles and in medicine are treated in detail. New techniques and instrumentation for conducting research and for applying existing knowledge to practical requirements are described.

C. V. R.

The Liver, Morphology, Biochemistry and Physiology (Vol. 2). Edited by Ch. Rouiller. (Academic Press, New York and London), 1964. Pp. xiv + 674. Price \$24.00.

In writing this treatise, the authors offer in a comprehensive form the present state of knowledge of the liver as based on morphological, biochemical, and physiological studies. The areas of greatest emphasis include a correlation of structural, functional, and biochemical aspects, recent findings established through modern methods of investigation, and experimental studies with animals of pathological changes in the liver.

The following is the list of the fifteen contributions contained in this volume: Excretory Function of the Liver, by Burton Combes; Functions of the Kupffer Cells, by B. Benacerraf; Regeneration of the Liver, by Elizabeth H. Leduc; The Liver and Steroid Hormone Metabolism, by C. B. Cameron; The Liver and Vitamins, by O. Wiss and F. Weber; Liver and Blood Coagulation, by C. A. Bouvier and P. A. Maurice; Liver Function Tests, by Gerard Milhaud; Methods and Techniques for Measurement of Hepatic Physiology and Metabolism, by William C. Shoemaker; Death of Liver Tissue; A Review of Cell Death, Necrosis, and Autolysis, by Guido Majno; Experimental Dietetic Injury of the Liver, by Edgar B. Taft; Experimental Toxic Injury of the Liver, by Ch. Rouiller; Experimental Cirrhosis, by W. Stanley Hartroft; Carcinoma of the Liver in Man, by Hans Elias; Liver and Viruses: Experimental Studies, by Everett C. Bracken, Glenn A. Gentry, and Charles C. Randall; and The Necrotropic Liver-Protective Substances, by W. Eger.

Further, each chapter is documented with references to recent literature and it is the

purpose of each contributor to communicate with specialists in fields other than his own.

C. V. R.

Rothamsted Experimental Station—Report for 1964. (Librarian, Rothamsted Experimental Station, Harpenden, Herts). Pp. 375. Price 15 sh. Post free.

The Report for 1964 follows the pattern of the previous Reports and gives an account of the progress of the investigations during the year in the various departments and experimental farms. The General Report of the Director, Dr. F. C. Bawden, focuses attention on the Station's work on resistance to insecticides, the health of potato seed tubers, problems of light-land farming at Woburn, and soils and fertilizers. There are three review articles, the first on "The potato variety King Edward VII and paracrinkle virus" in which the authors F. C. Bawden and B. Kassanis show that most of the features of paracrinkle virus generally accepted in the 1930's as established have since been proved to be incorrect. The second review article is on "Electrical charges on clay" by G. H. Cashen, and the third is on "Aphid nutrition and reproduction" by C. J. Banks.

A. S. G.

Books Received

Atoms and Molecules Simply Explained—An Introduction to Chemical Phenomena and Their Applications. By B. C. Saunders and R. E. D. Clark. (Dover Publications, New York-14), 1965. Pp. v + 299. Price \$1.50.

Elements of Structural Geology. By E. S. Hills. (Asia Publishing House, Calicut Street, Ballard Estate, Bombay-1), 1965. Pp. xi + 483.

Science in the Age of Space. By Dan Q. Posin. (Quadrangle Books Inc., 180, North Wacker Drive, Chicago-60606), 1965. Pp. 217. Price \$4.95.

Basic Electrical Engineering. By A. Kasatkin and M. Perekalin. (Gordon & Breach, Science Publishers, New York-11), 1965. Pp. 386. Price \$9.50.

Technical Thermodynamics. By V. V. Sushkov. (Gordon & Breach, Science Publishers, New York-11), 1965. Pp. 396. Price \$9.50.

Biochemistry of Quinones. Edited by R. A. Morton. (Academic Press, Berkeley Square, London W. 1), 1965. Pp. xvii + 585. Price 117 sh. 6 d.

A Gateway to Abstract Mathematics. By E. A. Maxwell. (Cambridge University Press, London, N.W. 1), 1965. Pp. 139. Price 16 sh.

THE NEW PHYSIOLOGY OF VISION

Chapter XXXIII. The Testing of Colour Vision

SIR C. V. RAMAN

THE lectures delivered under the auspices of the Indian Academy of Sciences on the 21st and 22nd December 1965 in the Chemistry Theatre of the Osmania University at Hyderabad were attended by the students of the University in large numbers. After the lectures given on the forenoon of the second day, there was an hour left free for other activities. The author decided to make use of this opportunity for an examination of the colour vision of those who had attended the lectures. The suggestion met with an enthusiastic response. Those volunteering for the test moved to an adjoining lecture theatre which was much better lighted and the examination then proceeded.

The aim was, in the first instance, to pick out those whose colour vision was defective and then to examine their colour sense in greater detail. The number of persons to be examined being large, the preliminary selection had to be made quite speedily. One after another, they were shown two sheets of a test-chart and asked to read the numbers shown therein. The first sheet contained the number 12 printed in orange surrounded by a field of dots of a bluish colour. The second sheet was selected at random from amongst those contained in the chart. All read the first sheet without any difficulty or hesitation. Those who read the second sheet shown to them without hesitation or error were also eliminated from the test.* Only eight of the men students were thus left over and they were then tested more fully. It emerged that four of the eight chosen in the preliminary selection were not really defective in their colour vision. The remaining four were then more carefully examined. They will be referred to in what follows as Suryan, Chandran, Shukla and Krishna respectively. These, of course, were not their real names.

Something should be said here about the nature of the charts used for the testing. Those were the well-known Ishihara Charts of which the 1958 edition was available containing 38 plates. Of these, only 25 are intended for general use. These again may be divided into five groups. Charts 2 to 9 are designed

so that the numbers would be read wrongly by colour-blind persons, while charts 10 to 17 could not be read at all by them. Of the remaining charts, 22 to 25 are of special interest, as they have been designed to distinguish between three groups, "the completely red-blind", "the completely green blind" and "the normal and incompletely red-green blind" persons from each other.

Suryan, Chandran and Shukla were unable to read charts 9 to 17. Krishna, on the other hand, could read some of them correctly, some incorrectly and others not at all. All four of them, however, had difficulties with charts 2 to 8. From these findings, it was evident that while Suryan, Chandran and Shukla were definitely colour-blind, Krishna could not be definitely classed as such. Each of the four were then shown the two exhibits of interference colours and were given sufficient time to observe them carefully and to write down in their own words what they could notice in them. This was done in a verandah, the exhibits being placed on a low parapet, so that the interference patterns could be seen by reflected sky-light incident nearly normally on the air-films exhibiting the colours. One of the exhibits was a set of circular rings of the well-known Newtonian type. But the air-film at the centre was not of zero thickness, so that a blue patch appeared at the centre of the pattern. This was surrounded by a ring of yellow, beyond which again appeared other interferences exhibiting cycles of colour in which red and green were predominant, alternately following each other. The other exhibit showed the interferences in the opposite order. Red and green were the principal colours in the innermost region and they were followed by other colour sequences of the same nature as in Newton's rings. But the colour progression began at the outer margins where the interferences of lowest order were observed. In these latter regions, the fluctuations of brightness were the principal features of the pattern.

The weight to be attached respectively to the observations reported by the four observers depends on their ability to observe correctly

and express themselves clearly and to some extent also on the extent of their experience of laboratory work. It should therefore be mentioned that Suryan had already taken his Bachelor's degree and was engaged in post-graduate studies in physics. Chandran had not yet taken his degree, but his record of observations is clear and systematic. Shukla and Krishna were both undergraduates.

Suryan described the Newtonian pattern as a succession of rings, beginning with blue at the centre and followed by yellow and by blue rings alternately. But he stressed the fact that the outer rings did not exhibit such full colours as the earlier ones and that the outermost rings could be described as being alternately dark and bright, the differences in brightness however not being much. Chandran reported observing that in the Newtonian pattern, the rings appeared as alternately violet and yellow, beginning with violet. He counted nine such rings in all and stressed the fact that the colours become progressively lighter as we proceed outwards in the pattern. Shukla also reported a succession of rings, of which he could see several. But he evidently found some difficulty in naming the colours which he observed. Krishna's descriptions of the Newtonian ring pattern resemble closely with that of a normal observer.

The reports of their observations by Suryan and by Chandran on the colours observed in the second exhibit of interferences agree closely. Near the margin of the pattern where the interferences are of low order, they both reported that the rings appeared alternately yellow and blue. Suryan stressed that the yellow rings of low order appeared brighter than those of lower order. Shukla observed the succession of interferences but here again, he had some difficulty in naming the colours he observed. Krishna's description of this pattern closely resembles that of a normal observer.

Thus, the first two of the four subjects whose vision has been studied can be recognised on the basis of their own reports as cases of daltonism, in other words, as persons who observe a two-colour spectrum of yellow and blue. It would, of course, have been desirable to examine their ability to observe and distinguish colours in greater detail, using the

methods described in the preceding chapter, viz., by exhibiting a spectrum of sufficient intensity on a ground-glass screen and examining their perception of luminosity and colour in its different parts. But the opportunity for such examination did not exist in the circumstances of the case.

A few remarks may be appropriately made here regarding the manner in which a pattern of interference colours would present itself to the vision of a person whose colour sense is daltonian. In the case of a normal individual, the nature of the pattern is essentially that determined by the yellow sector of the spectrum, viz., a succession of maxima and minima of illumination whose positions are determined by the wavelength $579\text{ m}\mu$ in the spectrum at which the sensation is a pure yellow. The contrast between the maxima and minima would fall off progressively, but some five or six of each would be perceivable. Superposed on this pattern which would be of a yellow colour, appear the effects arising from the green and red sectors of the spectrum, and to a lesser extent also of the blue sector of the spectrum. The daltonian, on the other hand, would only perceive the blue sector of the spectrum, this appearing superposed on the effect of the yellow sector. The blue sector and the yellow sector would each individually exhibit a series of maxima and minima of illumination. But their superposition would result in the blue being visible only where it is very bright and the yellow is very feeble. *Per contra*, where the blue is very feeble and the yellow very bright, the latter colour alone would be perceived. Elsewhere, the superposition would result in effacing colour, but the maxima and minima of illumination due to the predominant yellow colour would continue to be observable. These consequences appear to be borne out by the observations by the two persons with daltonian colour sense reported above. So far as it is possible to draw any valid conclusions from the somewhat cursory studies which alone were possible in the circumstances, it would seem that both of them could be described as completely colour-blind, in the sense that they could not perceive either the red or the green colours which are such a conspicuous feature to a normal observer in the interference patterns.

THE INDIAN ACADEMY OF SCIENCES—THIRTY-FIRST ANNUAL MEETING

THE Thirty-first Annual Meeting of the Indian Academy of Sciences was held on 20, 21 and 22 December 1965, in Hyderabad, under the auspices of the Osmania University. The Conference was inaugurated by Mr. Pattom Thanu Pillai, Governor of Andhra Pradesh. Dr. D. S. Reddy, Vice-Chancellor of the University, welcomed the gathering.

Sir C. V. Raman, President of the Academy, in his Address on "The New Physiology of Vision" presented the results of his latest researches on the subject with particular reference to his new theory on defects in colour vision and "daltonism".

The next two days of the Conference were devoted to scientific meetings which were held in two sessions on each day. Presiding over the morning session on the 21st, Dr. M. S. Krishnan spoke on "The Earth's crust—its development and structure". This was followed by a lecture on "The present state of development of rocket and satellite meteorology" by Mr. C. Ramaswamy, and a paper on "The electron paramagnetic resonance in ferro-electric systems" presented by Dr. P. Venkateswarlu. In the afternoon session the Chairman Prof. T. S. Sadasivan spoke on "Phytotoxicity", and Prof. S. Ramaseshan on "The use of anomalous scattering of X-rays in crystal physics".

The second day's morning session was presided over by Dr. S. Bhagavantam who gave a talk on "Magnetic properties of crystals". Prof. S. Chandrasekhar spoke on "Liquid crystals". In the afternoon session Chairman Dr. T. R. Govindachari in his talk pointed out that the triterpenoid euphol acted as a biogenetic intermediate for the formation of a variety of complex substances. Dr. M. K. Vainu Bappu spoke on "Cometary spectra".

There were two evening lectures the first on the 21st, by Dr. M. S. Swaminathan on "Plant Genetics and food production" and the second on the 22nd by Prof. M. G. K. Menon on "Cosmic ray neutrino experiments".

The following are the summaries of some of the lectures delivered at the meeting:—

Phytotoxicity

T. S. SADASIVAN

University Botany Laboratory, Madras-5

Phytotoxicity as a fundamental problem has been recognized for over half a century, but its importance is gaining ground ever since the discovery of powerful chemotherapeutants

and antibiotics. We are now entering into an age of systemic fungicides. Therefore, to keep pace with these newer developments a more critical study of life processes in plants like permeability, ion uptake, respiration, photosynthesis and the production of a group of interesting substances like phytoalexins seems essential. This is particularly so in a tropical country like India where application of proprietary fungicides without adequate knowledge of host physiology such as an accelerated basal metabolism under prevailing conditions could be ruinous. Fungicides have been applied in recent years both through the foliage and in soil and, indeed, the pathways have been elucidated through tracer techniques. Thus, the effects of the antibiotic chloramphenicol in inducing restraint in ion uptake and their active transfer across root membranes and the inhibition both in the uptake and subsequent incorporation of amino-acids into protein are now known. In our own work on cotton with fusaric acid (*n*-butyl pyridine dicarboxylic acid) we have shown ionic imbalance, altered oxidation-reduction potential, reduced chlorophyll, changes in protein and soluble nitrogen. Working with various systemic fungicides on rice, susceptible and resistant to helminthosporiosis, we have also noticed observable phytotoxicity and an altered pattern in the soluble nitrogen components. Various reports indicate that phytotoxic effects accrue even at the time of seedling germination.

Recently the effect of some fungicide sprays on the synthesis of chlorophylls, DNA and RNA in onion leaves has shown that the synthesis of both chlorophyll 'a' and DNA was inhibited by cycloheximide, whereas content of RNA increased more than twofold in treated leaves. The fungicide dyrene seemed to favour synthesis of chlorophylls in developing leaves. All this indicates the vastness of this problem of phytotoxicity and underlines once again the need to understanding the physiology of a plant system under the stress of chemicals and antibiotics.

The Earth's Crust—Its Development and Structure

M. S. KRISHNAN

*Geology Department, Osmania University
Hyderabad*

Whatever origin is attributed to the Earth, it must have passed through a molten

state in the course of contraction. The age of the Earth is taken to be the same as that of the meteorites, about 4600 m.y. The greatest age got for rocks from the Pre-cambrian shields (from the White Sea coast in the Baltic shield, from Southern Rhodesia and Swaziland) is 3500 to 3600 m.y. This is very nearly the age of the first permanent crust, for the original crust must have been remelted while the crust was still hot. Life must have appeared at least 1000 m.y. later, but recognisable organic structures appear about 1600 to 1800 m.y. ago.

The original crust was of basaltic composition. It may have segregated around the poles or in the equatorial region. It was gradually differentiated, during the course of ages, by repeated igneous action and crustal movements involving fusion and by the addition of increasing quantities of sediments.

The Earth has been evolving as a density-stratified spheroid, with a metallic core and a mantle containing silicates, sulphides and other compounds. The Upper Mantle, down to perhaps 700 Km. or even 950 Km. depth, is non-uniform in composition and is the shell in which silicates and other compounds undergo phase changes due to change in density. Primary magma chambers occur at depths between 60 and 200 Km. though earthquake foci occur down to 700 Km, mainly by change of density in either direction. The Mohorovicic discontinuity, which occurs at depths between 20 and 85 Km. in continents (average around 33 Km.) and 5 to 10 Km. in ocean basins, is believed to mark the change of basalt to eclogite under the continents but may indicate only a density change under the oceans.

The earth shows folded mountains thrust over the edge of the Pacific Ocean while the Atlantic and Indian oceans are surrounded by faulted coasts. These features have been produced by the drift of continents which began in the Upper Mesozoic and have been completed in the Pleistocene. The final adjustments are still taking place. Other connected features are the Rift Valleys and major grabens like the Rhine Valley, White Sea-Caspian depression, the Ob-Aral Sea depression, etc. The present active features are the Mid-Ocean ridges and the Island Arcs. The Mid-Ocean ridges are bringing up basaltic lavas and building up a huge sub-oceanic mountain system in all the major oceans. The Island Arcs around the Pacific coasts mark major fault planes dipping under the continents and they

contain the foci of greater majority of earthquakes occurring at present. Along these arcs also rise basaltic and andesitic lavas and ashes. Both these features are now actively contributing to the addition of crustal material. There is thus an equilibrium between the wearing down of continents and addition to their material. The continents are however believed to be growing in extent gradually.

Plant Genetics and Food Production

M. S. SWAMINATHAN

*Indian Agricultural Research Institute
New Delhi*

India has over 20,000 species of flowering plants in the country, a number far surpassing that found in countries of a much larger land area such as the U.S.S.R. and U.S.A. The primary natural endowments necessary for successful plant growth are abundant sunlight and adequate moisture. The laws of heredity discovered by Gregor Mendel in 1865 have made it possible for us to synthesise plant varieties which can utilise more efficiently solar energy as well as chemical energy applied in the form of organic and inorganic manures. Genes or the factors determining hereditary characteristics are located on rod-like bodies called chromosomes, whose number is constant in every species. While the history of the earth is written in its layers, the history of all living organisms is inscribed in their chromosomes.

Through a process of genetic and chromosome engineering, very high yielding varieties of Rice and Wheat and hybrids of Maize, Jowar and Bajra (Cumbu) have been developed during the past 4 years. These varieties and hybrids if grown with adequate quantities of fertilizer and water can yield 4 to 6 tons of grain per hectare. Since a minimum of 2 crops can be grown in our irrigated lands, the yield potential of our lands can be as high as 10 to 12 tons of grain per hectare. In fact, at the Division of Botany, Indian Agricultural Research Institute, New Delhi, 5.8 tons of maize were harvested in October, 1965 in the same hectare of land in which 6.3 tons of wheat had been harvested in April, 1965. Such a favourable situation for high production does not exist in the temperate areas of the globe. Plant Genetics has ushered in a hopeful era in Indian agriculture by opening up new vistas in crop yields. The 9 million tons of Jowar currently being produced in India from 43

million acres can easily be produced in a maximum of 9 million acres, since 1 ton per acre can be obtained with the hybrid *Jowar* varieties even by poor farmers. Thus, altogether new land use patterns can be envisaged. The varieties or hybrids recently produced by our geneticists are all maturity-oriented and can be grown in any season, provided there is water and the temperature is not too unsuitable. Hybrid *Jowar* can be grown in the paddy fallows of Andhra Pradesh and Madras and in this way, the traditional *Jowar* lands can be utilised for other purposes.

We in India are only at the beginning of the scientific age with reference to agriculture. The new genetic tools have conferred upon man the powers to create new varieties. The branched wheats evolved at the Indian Agricultural Research Institute through the use of atomic radiations will open up a new dimension in wheat yields. The production of amber-coloured grains from Mexican wheat varieties

with red grains within 2 seasons is an example of the rapid progress possible.

Genetic manipulation of quality has just begun and already wheat varieties with over 14% protein content have been selected. The discovery made at the Nutritional Research Laboratories, Hyderabad, that excess of the amino-acid leucine in the *Jowar* grain is responsible for the occurrence of pellagra in populations mainly subsisting on *Jowar* has paved the way for breeding *Jowar* varieties low in leucine content.

The rapid increase in the demand for fertilizers during the last few years is due to the striking response shown by the new varieties and hybrids to fertilizer application. During the spread of intensive agricultural practices, new problems such as new diseases and pests will crop up and it is essential that genetic research in the country is developed to the extent necessary for anticipating some of these problems and solving them quickly.

BEHAVIOUR OF NONHUMAN PRIMATES *

THIS is a work which surveys modern laboratory and field research on the behaviour of monkeys and apes; its publication should be welcomed by students of behaviour who have felt the need for a convenient source of information about the behaviour of the animals most closely related to man.

Among the topics covered are learning, behaviour development, aging, social behaviour, and effects of ionizing radiations. The material is directed towards research workers who are unfamiliar with the techniques, problems, and findings of primate research as well as specialists in the field. It should also be useful to advanced undergraduate and graduate students in psychology and to researchers in related fields such as anthropology, neurophysiology, sociology, and zoology.

* *Behaviour of Nonhuman Primates: Modern Research Trends*, Volumes I and 2. Edited by Allan M. Schrier, Harry F. Harlow and Fred Stollnitz. (Academic Press, New York and London), 1965.

Volume I: Pp. xv+285+33. Price \$ 9.00.

Volume II: Pp. xv+309+33. Price \$ 9.50.

Volume I contains the following articles: Discrete-Trial Training Techniques and Stimulus Variables, by Donald R. Meyer, F. Robert Treichler, and Patricia M. Meyer; Discrimination-Learning Sets, by Raymond C. Miles; Hypothesis Behaviour, by Marvin Levine; The Delayed-Response Problem, by Harold J. Fletcher; Associative Problems, by Gilbert M. French; Operant Conditioning, by Roger T. Kelleher; Primate Learning in Comparative Perspective, by J. M. Warren.

Volume II contains the following articles: The Affectional Systems, by Harry F. Harlow and Margaret K. Harlow; Determinants of Social Behaviour in Young Chimpanzees, by William A. Mason; Ontogeny of Perception, by Robert L. Fantz; Ontogeny of Learning, by Robert R. Zimmermann and Charles C. Torrey; Age Changes in Chimpanzees, by A. J. Riopelle and C. M. Rogers; Investigative Behaviour, by Robert A. Butler; The Radiation Syndrome, by Roger T. Davis; Field Studies, by Phyllis Jay.

USE OF HAPLOIDS IN *GOSSYPIMUM BARBADENSE* L. AS A SOURCE OF ANEUPLOIDS

J. E. ENDRIZZI

Plant Breeding Department, College of Agriculture, The University of Arizona, Tucson, Arizona

THE immense value of chromosome-deficient lines for the genetic analysis of individual chromosomes as well as for the analysis of the genetic structure of the whole genome has been well established in wheat and tobacco.

In the last few years efforts have been underway to assemble a complete series of monosomes for the 26 chromosomes of the cultivated tetraploid cottons, *Gossypium hirsutum* L. and *G. barbadense*. A number of monosomes have been isolated in *G. hirsutum*, but almost all of these were recovered from source material not originally designed for isolating chromosome deficiencies.¹ So far none of these sources in cotton have yielded monosomes at a frequency comparable to some of the sources used in wheat,² tobacco,³ and oats^{4,5} for recovering monosomes. Furthermore, most sources in cotton were specific for the kind of monosome they yielded, thereby prohibiting their further use for isolating monosomes representing other chromosomes of the series. Monosomes for seven of the 26 chromosomes in cotton have been identified and reported.⁶

At least two laboratories are currently experimenting with various techniques and materials to find a means of producing a high frequency of monosomes in cotton to complete the chromosome-deficient series. This report describes the results of testing one kind of material, i.e., haploids, as a means for recovering a high frequency of monosomes.

One of the chief sources of monosomes in wheat was found in the analysis of the progeny of haploid plants pollinated with pollen from normal wheat.² Haploids from five different lines of *G. hirsutum* were pollinated over a long period with pollen from normal plants but not a single seed was produced.⁷ It is the general concurrence among cotton workers that haploids of *G. hirsutum* are completely sterile; however, haploids of *G. barbadense* on the other hand are partially fertile and will produce a few seeds when pollinated with normal pollen.

The doubled haploid line 57-4, of *G. barbadense*, produces as high as 61% haploids in its progeny.⁸ In 1964, 50 seeds of 57-4 were

planted singly in peat pots and 45 seedlings were transplanted to the field. Of the 45 plants, 22 were haploids and 23 were diploids ($2n = 4X = 52$). When the haploids commenced flowering, open blossoms were hand-pollinated daily throughout most of the season with pollen from a normal line of *G. barbadense*, 3-79. Three hundred and twenty-five normal-sized seeds having dark testa were harvested from the 22 haploid plants, which is an average of approximately 15 seeds per haploid plant. The number of bolls with one to four seeds are as follows: 209 bolls with one seed, 49 with 2 seeds, 7 with 3 seeds and 1 with 4 seeds. As expected boll size is proportional to the number of seeds in a boll.

The 325 seeds were planted singly in peat pots and 189 germinated. The non-germinated seeds were dug up, dissected and found to be empty. The 189 seedlings were transplanted to the field where only 160 survived. Table I shows the results of analysis of 121 of the 160 plants. Only three simple monosomes were recovered. One plant showed 24 II + chain of III at meiosis (Table I). It is believed that the

TABLE I

Cytotypes and their frequency in the progeny of haploids of *G. barbadense*

	24 II	25 II	25 II	24 II
	+	+	+	+
	III	telosome	III	IV
n*	26 II	2n-1		
21	91	3†	1	2**

* n = haploid.

† One plant was 24 II + telosome + I.

** The extra chromosome in one plant was a telosome.

pairing relationships in this plant can be better explained by a chromosome interchange accompanied by a loss equivalent to a whole chromosome rather than by the duplication and deficiency of whole chromosomes. If a duplication-deficiency phenomenon was involved, such a plant would be nullisomic for one pair of chromosomes and trisomic for another pair. This is highly unlikely in view of the fact that nullisomics have not been recovered in cotton.

On the assumption that an interchange is involved in the chain of III and that a normal set of chromosomes was contributed by the male gamete, the deficiency, therefore, involves portions of two chromosomes. The recovered monosomes in the progeny of 57-4 haploids represent about 2 to 3% of the analyzed population, which is a rather low frequency. The 57-4 haploids, therefore, are not a very efficient source for recovering whole chromosome deficiencies. Since Sears⁸ found 16 monosomes among the 13 immediate progeny of a wheat haploid pollinated with normal pollen, it was disappointing to find such a low frequency of monosomes in the progeny of the cotton haploids. It is possible that since the haploid-including mechanism is genetically controlled⁸ and expressed in haploids, as well as diploids, the mechanism itself may preclude a high production of monosomes.

Other chromosomal structural types recovered from the cotton haploid were telosomes, trisomes, and translocations. Since trisomes and translocations were also recovered in the progeny of the wheat haploid, the cotton and wheat results are related. Therefore, it is assumed that the

aberrations recovered in the progeny of the cotton haploids originated in a manner similar to that proposed by Sears⁹ for the origin of the aberrations recovered in the progeny of the wheat haploid.¹⁰

1. Meta, S. Brown and Endrizzi, J. E., *Am. J. Bot.*, 1964, **51**, 108.
2. Sears E. R., *Mo. Agric. Exp. Sta. Res. Bull.*, 1954, pp. 572-59.
3. Clausen, R. E. and Cameron, D. R., *Genetics*, 1944, **29**, 447.
4. Rajbathy, T. and Dyck, P. L., *Can. J. Genet. Cytol.*, 1964, **6**, 215.
5. Andrews, G. T. and McGinnis, R. C., *Ibid.*, 1964, **6**, 349.
6. White, T. G. and Endrizzi, J. E., *Genetics*, 1965, **51**, 605.
7. Endrizzi, J. E., Unpublished.
8. Turcotte, E. L. and Feaster, C. V., *Science*, 1963, **140**, 1470.
9. Sears, E. R., *Genetics*, 1939, **24**, 509.
10. Contribution No. 1044 from the Arizona Agricultural Experiment Station. Part of this work was done under Regional Cotton Genetics and Cytology Project S-1 of the Research and Marketing Act of 1946.

ACTION OF ALKALINE HYDROGEN PEROXIDE ON α -METHOXY CHALKONES

A. C. JAIN, V. K. ROHATGI AND T. R. SESHADRI

Department of Chemistry, University of Delhi, Delhi-7

2'-HYDROXYCHALKONES are well known to undergo cyclisation to give flavanones both by acid and by alkali.¹⁻⁶ However, the presence of an α -methoxy group directs the cyclisation to give a coumaran-3-one derivative. Though α -methoxy-2'-hydroxychalkones have been isolated from chalkone condensations which required alkaline conditions, they undergo change if left in contact with dilute alkali for a long time and the products are 2-methoxy-2-benzyl coumaran-3-one derivatives.⁷ The same products are also formed when the chalkones are heated at 200° *in vacuo*.⁸ α ,2'-Dihydroxy chalkones are rather difficult to isolate in chalkone condensations and the product is generally a 2-hydroxy-2-benzylcoumaran-3-one derivative.⁹ Under acidic conditions

demethylation is possible and α -methoxy-2'-hydroxychalkones give two products, viz., 2-methoxy-2-benzyl coumaran-3-one derivative and the corresponding 2-hydroxy compound.⁷⁻¹⁰

2'-Hydroxychalkones undergo oxidation with alkaline hydrogen peroxide called Algar-Flynn-Oyamada oxidation or simply A.F.O. reaction and the nature of the products depends on the substituents and the temperature.¹¹⁻¹² When there is no 6'-substituent in the chalkone, flavonols are the main products; aurones are formed only in small amounts. However, if a 6'-substituent is present and there is no free hydroxyl in 2 and 4 positions, aurones are major products and flavonols are the minor ones. The situation is reversed if there is a free hydroxyl in either 2 or 4 position, though there may be a

6'-substituent. Epoxides were considered earlier¹³ as the only intermediates in the reaction, but a satisfactory mechanism for the formation of all these products has been given very recently by Dean and Podimuang.¹⁴

The influence of α -methoxy group on A.F.O. oxidation was first examined in this laboratory¹⁵ and it was reported that 3-methoxyflavones were formed in good yields. The influence of α -methyl group has more recently been studied by Dean and Podimuang¹⁴ who showed that the product was 2-methyl- α -hydroxy-2-benzyl coumaran-3-one by n.m.r. and i.r. spectra. In view of this observation, the earlier results¹⁵ obtained in this laboratory were checked up, because α -methyl and α -methoxyl should have similar electronic effect.

The oxidation of 2'-hydroxy- α , 4', 6'-trimethoxy chalkone¹⁶ has now been studied first and the product obtained in 70% yield is a colourless compound melting at the same temperature as was recorded earlier.¹⁵ But it shows a much higher carbonyl frequency (1705 cm^{-1}) in the infra-red spectrum (using nujol mull) than that expected for galangin trimethyl ether (ν_{max} in penta-*o*-methyl quercetin is 1629 cm^{-1}).¹⁷ This is more in accordance with the coumaran-3-one structure (cf. aurone hydrates¹⁸ have CO frequency at about 1700 cm^{-1}) which is also supported by the characteristic u.v. spectrum showing an intense peak only at $290\text{ m}\mu$ ($\log \epsilon$, 4.30) (cf. aurone hydrates¹⁸); galangin trimethyl ether should show two bands one at about $250\text{ m}\mu$ and the other at about $320\text{ m}\mu$.¹⁹ Further, the product shows hydroxyl stretching frequency at about 3500 cm^{-1} which is not possible if it is galangin trimethyl ether. Hence its structure should be taken as 2-benzyl- α -hydroxy-2, 4, 6-trimethoxycoumaran-3-one and not galangin trimethyl ether as considered earlier.¹⁵

Two more α -methoxy-2'-hydroxychalkones have next been studied; they are 2'-hydroxy- α , 4, 4', 6'-tetramethoxychalkone²⁰ and 2'-hydroxy-3-benzoyloxy- α , 4, 4', 6'-tetramethoxychalkone.²¹ In these cases also, the products formed are not 3-methoxyflavones but they have the coumaran-3-one structures as shown by u.v. and i.r. spectra. Further work is in progress to

study the influence of substituents but this advance note has been necessitated because of a preliminary communication on a similar work published in the latest *Chemical Communications*²² received by us.

1. Kostanecki, S., Lampe, V. and Tambor, I., *Ber.*, 1904, **37**, 784.
2. Lowenbein, A., *Ibid.*, 1924, **57**, 1515.
3. Saiyad, F. Z., Nadkarni, D. R. and Wheeler, T. S., *J. Chem. Soc.*, 1937, p. 1737.
4. Matsuura, S., *Pharm. Bull. Tokyo*, 1957, **5**, 195.
5. Raut, K. B. and Wender, S. H., *J. Org. Chem.*, 1960, **25**, 50.
6. Mulchandani, N. B. and Shah, N. M., *Chem. Ber.*, 1960, **93**, 1918.
7. Eneback, C. and Gripenberg, J., *Acta Chem. Scand.*, 1957, **11**, 866.
8. Molho, D., Chopin, J. and Chadenson, M., *Bull. Soc. Chem. Fr.*, 1959, p. 454.
9. Grover, S. K., Gupta, V. N., Jain, A. C. and Seshadri, T. R., *J. sci. industr. Res.*, 1960, **19B**, 258.
10. Sukumato, T. T. and Tominaga, T., *J. Pharm. Soc. (Japan)*, 1953, **73**, 1172; *C.A.*, 1954, **48**, 12740.
11. Wheeler, T. S., *Rec. Chem. Progr.*, 1957, **18**, 133.
12. Philbin, E. M. and Wheeler, T. S., In *Recent Progress in the Chemistry of Natural and Synthetic Colouring Matters*, Eds. T. S. Gore, B. S. Joshi, S. V. Sunthakar and B. D. Tilak, Academic Press, New York, 1962, p. 167.
13. Geissman, T. A. and Fukushima, D. K., *J. Amer. Chem. Soc.*, 1948, **70**, 1686.
14. Dean, F. M. and Podimuang, V., *J. Chem. Soc., Lond.*, 1965, p. 3978.
15. Narasimhachari, N., Narayanswami, S. and Seshadri, T. R., *Proc. Ind. Acad. Sci.*, 1955, **37**, 104.
16. Kimura, Y. and Hoshi, M., *Proc. Imp. Acad. (Tokyo)*, 1936, **12**, 285.
17. Briggs, L. H. and Colebrook, L. D., *Spectrochim. Acta*, 1962, **18**, 939.
18. Grover, S. K., Jain, A. C. and Seshadri, T. R., *Ind. J. Chem.*, 1963, **1**, 429.
19. Jurd, L., In *The Chemistry of Flavonoid Compounds*, Ed. T. A. Geissman, 1962, p. 112.
20. Kimura, Y., *J. Pharm. Soc. Japan*, 1938, **58**, 415.
21. Anand, N. K., Gupta, S. R., Jain, A. C. and others, *J. sci. industr. Res. India*, 1962, **21B**, 322.
22. Donnelly, D. M. X., Lavin, T. P., Melody, D. P. and Philbin, E. M., *Chem. Comm.*, 1965, No. 19, p. 460.

LETTERS TO THE EDITOR

NUCLEAR MAGNETIC RESONANCE OF
Co⁵⁹ IN SOME PENTAMMINE Co (III)
COMPLEXES

CHEMICAL shifts in the nuclear magnetic resonance of Co⁵⁹ reported so far by earlier workers¹⁻³ in several cobaltic complexes appear to have been satisfactorily interpreted on the basis of the ligand field theory. From the n.m.r. data Dharmatti and Kanekar⁴ established an order of increasing field strength for a series of ligands which is in general conformity with the spectrochemical series. Their work was restricted to a few representative cobaltic ammines. We have now studied several compounds containing pentammine cobaltic ion [Co(NH₃)₅X]²⁺ in which the ligand X was varied in order to ascertain its ligand field strength in the pentammine series.

The observed data are given in column 4 of Table I. The shifts have been expressed as

This indicates that the contribution due to the second-order paramagnetism to δ decreases in this order.

On the basis of the theory of Griffith and Orgel⁵ the ligand field strength should also increase in the same order as given above in this series. The absorption spectra of all these pentammines were also studied in the visible region and from the weak *d-d* band the energy separation between the ground state ¹A_{1g} and the excited state of ¹T_{1g} of the *d⁶* configuration of cobalt in these complexes was estimated (column 2). The order of the ligand field strengths obtained from these values are in fair agreement with that found from the n.m.r. data although the two results are not identical in all respects.

Using optical data, values have also been calculated for the contribution of second-order paramagnetism to δ in all these complexes in the

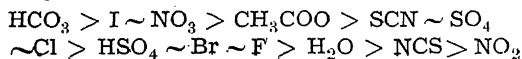
TABLE I

Comparison of the observed chemical shifts with those calculated from ligand field theory

Compound		Energy separation between the ground and the excited state of <i>d⁶</i> configuration of cobalt (cm. ⁻¹)	$\delta\%$	
			Observed	Calculated
1. [Co (NH ₃) ₅ ONO] Cl ₂	..	21,050	0.75	0.82
2. [Co (NH ₃) ₅ NO ₂] Cl ₂	..	20,750	0.749	0.85
3. [Co (NH ₃) ₅ H ₂ O] Cl ₂	..	20,410	0.831	0.89
4. [Co (NH ₃) ₅ CH ₃ COO] (NO ₃) ₂	..	19,920	0.891	0.96
5. [Co (NH ₃) ₅ NCS] Cl ₂	..	19,840	0.820	0.96
6. [Co (NH ₃) ₅ HCO ₃] (NO ₃) ₂	..	19,680	0.900	0.98
7. [Co (NH ₃) ₅ NO ₃] Cl ₂	..	19,610	0.893	0.99
8. [Co (NH ₃) ₅ SCN] Cl ₂	..	19,610	0.876	0.99
9. [Co (NH ₃) ₅ F] Cl ₂	..	19,610	0.871	0.99
10. [Co (NH ₃) ₅ SO ₄] Cl	..	19,050	0.875	1.06
11. [Co (NH ₃) ₅ HSO ₄] Cl ₂	..	18,870	0.872	1.09
12. [Co (NH ₃) ₅ Cl] Cl ₂	..	18,870	0.875	1.08
13. [Co (NH ₃) ₅ Br] Br ₂	..	18,350	0.871	1.16
14. [Co (NH ₃) ₅ I] Cl ₂	..	17,240	0.894	1.34

$\delta\%$ defined as $(H_i - H_r)/H_r \times 100$, where H_i is the resonance field for the compound studied and H_r that of K₃Co(CN)₆, the reference compound. The observed values are negative as the resonance for all these compound occurs at fields much lower than that for the reference.

It is seen from the results that, for the series of ligands X in these pentammines, δ decreases in the order



manner indicated by the Griffith-Orgel theory (last column); these values are in fair agreement with the observed data. However, serious discrepancies are observed for the bromo and the iodo complexes; here, the difference between the observed and calculated data is much higher than 20% which is the upper limit of the errors involved in the theoretical calculations. It may be concluded from these results that although the theory of Griffith and Orgel explains the n.m.r. shifts satisfactorily in most

cases it needs refinements. The lack of satisfactory agreement between the theory and experiment for the bromo and iodo complexes may be due to the fact that the model underlying the theory neglects bonding effects; in the halopentammine series where the ionic character of the cobalt halogen-bond decreases from F to I, the discrepancy between the theory and experiment also increases progressively in the series.

Our results also show that the thiocyanato and the isocyanato complexes can be clearly identified with the help of n.m.r. There is a chemical shift of about 5.6 gauss (at 10 K. gauss) between these two isomers. The thiocyanato complex gave two lines; the intensity of one was more than the other. The weaker line was identified to be due to the isocyanato isomer from its position, which corresponded exactly with that of the line observed in a separate experiment for the pure isocyanato complex. It is evident that the thiocyanato complex prepared by conventional method has an impurity of the isocyanato isomer. The absorption maxima corresponding to $d-d$ transition for the two isomers lie very close to each other ($510\text{ m}\mu$, $\epsilon_{\text{max.}} = 25.8$ for thiocyanato compound and $504\text{ m}\mu$, $\epsilon_{\text{max.}} = 51.2$ for the other isomer). It is therefore difficult to distinguish between these isomers from merely their absorption spectra in the visible region.

The authors are thankful to Shri M. A. Pujar, Karnatak University, Dharwar, for preparation of these complexes and Shri V. R. Marathe for running the n.m.r. spectra.

Tata Institute of Fundamental Research, Bombay-5,
and

Department of Inorganic Chemistry,
Karnatak University, Dharwar,
November 10, 1965.

N. S. BIRADAR.

ON LOW-LYING EVEN-PARITY LEVELS OF ^{18}F NUCLEUS

CALCULATIONS¹ for the nuclei with $A = 18$ have been made on the basis of the intermediate-coupling individual particle model with a modified Gaussian potential and with both Serber and Rosenfeld exchange forces. These nuclei are treated as an even-even core, $A = 16$ nucleus plus two nucleons in $1d$ and $2s$ harmonic oscillator orbitals.

The two-nucleon interaction energy matrices for the ten different states $(JT) = (10), (30), (40), (50), (11), (21), (31), (41), (01), (20)$, are constructed and diagonalized following the method of Redlich² and Elliot and Flowers³ with the two-nucleon interaction $V(r) = (V_0 e^{-r^2/r_0^2}) / (r/r_0)$ where $V_0 = -70.8\text{ MeV}$ and $r_0 = 1.498 \times 10^{-13}\text{ cm}$. This potential is intermediary⁴ to the usual Yukawa and Gaussian potentials and, in conjunction with the Serber force, explains⁵ the ground state binding energies of a large number of nuclei.

TABLE I

Calculated energy level orders of ^{18}F nucleus

State (JT)	Energy (in MeV) with Serber Exchange force	State (JT)	Energy (in MeV) with Rosenfeld Exchange force
(10) _a	0	(10) _a	0
(30) _a	3.093	(30) _a	5.453
(50) _a	3.662	(50) _a	6.800
(10) _b	5.168	(10) _b	8.445
(20) _a	5.537	(20) _a	9.113
(30) _b	6.635	(10) _c	10.50
(10) _c	7.396	(30) _b	10.89
(40) _a	8.705	(40) _a	11.88
(20) _b	9.549	(20) _b	14.24

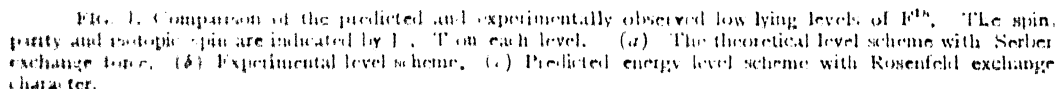
The suffixes a, b and c of the state (JT) indicate the levels in increasing order, a being the lowest.

The first few predicted energy levels ($T = 0$) for ^{18}F nucleus with both the Serber and Rosenfeld forces are given in Table I. Here the lowest $J = 1$ and $T = 0$ energy is treated as the observed ground state of the ^{18}F nucleus and the remaining levels are calculated relative to this energy. The relative positions of the energy levels with $T = 1$ with respect to those with $T = 0$ as well as the level spacings within the $T = 1$ group are found to be highly sensitive to the assumed exchange character. A study and comparison of these levels with the observed levels (with $T = 1$) in ^{18}F nucleus will be reported later.

A comparison of the predicted energy spacings with those experimentally observed indicates that the predicted energy spacings are large. The estimated energy spacings are enhanced even

1. Proctor, W. G., and Yu, F. C., *Phys. Rev.*, 1951, **81**, 20.
2. Freeman, Murray and Richards, *Proc. Roy. Soc. London*, 1957, **242 A**, 455.
3. Dharmatti, Kanekar and Mathur, *Symposium on Co-ordination Compounds, National Academy of Sciences, (India), Agra*, 1959; N.A.S.I., Publication, 1960, Part II, p. 157.
4. — and —, *J. Chem. Phys.*, 1959, **31**, No. 1436-37.
5. Griffith, J. S. and Orgel, L. E., *Trans. Farad. Soc.*, 1957, **53**, 601.

on the Serber force. But the possibility that 2.53 MeV level can have 3^- is not supported by the measurements made at Oxford by Poletti



Another interesting result of the present calculation is the inversion of the $(30)_h$ and $(10)_e$ levels when we change from the Serber to Rosenfeld force. Both these levels however continue to be situated in between the $(20)_u$ and $(40)_u$ levels independent of the assumed exchange character. This inversion is not observed in earlier theoretical investigations.⁸ An experimental identification of the $(40)_u$ and $(20)_h$ levels together with the fact that the next shell model state, immediately below the $(40)_u$ state has either 1^+ or 3^+ would help to decide upon the probable exchange character of

Kuehner *et al.* have identified the 2.10 and 2.53 MeV levels on the basis of Redlich's calculations with (20) and (30)_h levels. This is in conformity with the present results based

the central interaction just based on the spin orders.

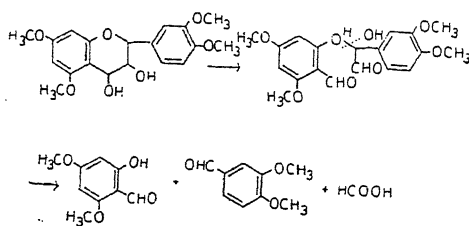
The author wishes to express his thanks to Dr. (Mrs.) C. Santhamma for her guidance and to the C.S.I.R. for the award of a fellowship. He is grateful to Prof. K. R. Rao for his interest and encouragement.

Andhra University, K. L. NARAYANA.
Waltair, November 11, 1965.

1. Narayana, K. L., *Ph.D. Thesis*, Andhra University, Waltair (Unpublished), 1964.
2. Redlich, M. G., *Phys. Rev.*, 1958, **110**, 468; *Ibid.*, 1955, **99**, 1427; *Ibid.*, 1954, **95**, 448.
3. Elliot, J. P. and Flowers, B. H., *Proc. Roy. Soc. (Lond.)*, 1955, **229 A**, 536.
4. Sasaki, K., *Prog. Theor. Phys. (Japan)*, 1963, **22**, 383.
5. Thieberger, R., *Phys. Rev.*, 1959, **116**, 713.
6. Poletti, A. R. and Warburton, E. K., *Ibid.*, 1965, **137 B**, 595; *Nuclear Data Sheets*, compiled by K. Way *et al.*, National Academy of Sciences, National Research Council, Washington, 25, D. C.
7. Kuehner, J. A., Almqvist, E. and Bromley, D. A., *Phys. Rev.*, 1961, **122**, 908.
8. Flowers, B. H. and Wilmore, D., *Proc. Phys. Soc.*, 1964, **83**, 683.

ACTION OF PERIODATE ON FLAVANDIOLS

THE use of periodic acid as a glycol-splitting agent is well known.¹ This has been made use of in the structural studies of flavan-3, 4-diols. Earlier oxidation studies have been carried out with naturally occurring leucoanthocyanidins. The periodic acid consumption of leucocyanidin has been quantitatively estimated.² It consumes 2 moles accounting for the glycol and catechol units. However, for the isolation of the oxidation products the methylethers are more convenient. King and Bottomley³ isolated 2-hydroxy, 3, 4-dimethoxy benzaldehyde as its semicarbazone by the oxidation of melacacidin methyl ether with periodic acid. Veratraldehyde and phloroglucinaldehyde dimethyl ether were isolated⁴ when leucocyanidin methyl ether was treated with an aqueous solution of periodic acid (50%) for 24 hr. at room temperature. The following mechanism has been suggested.

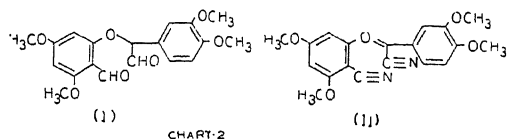


More recently periodic acid has been used in determining the configurations of leucoanthocyanidins.⁵ When the methyl ethers are employed, the *cis* diol consumes 1 mole of periodic acid in about 7 min. whereas the *trans* is much slower and takes 40 minutes.

There has been so far no definite criterion for the determination of the molecular size of leucoanthocyanidins as monomer, dimer, trimer or polymer. The method of using solubility in different solvents like ethylacetate has limited application and is not definite. On the basis that the 4-hydroxyl is involved in linking up with another polyphenol molecule and is thus locked up, it is possible to assay the end group by periodic acid titration. This is feasible only when the end group is a diol. If other polyphenols like catechins are involved then there will be no consumption of periodic acid. The method has quantitative application only in the case of homogeneous polymers. For determination of the constitution of new leucoanthocyanidin the fission method will be useful if both parts of the molecule could be obtained as recognisable units.

For purposes of standardisation of conditions and understanding the products, a leucoanthocyanidin of known structure was necessary. Therefore the synthetic leucocyanidin methyl ether has now been studied. It has been prepared by the borohydride reduction of taxifolin-5', 7, 3', 4'-tetra-O-methyl ether. Quantitative estimations using an aqueous solution of sodium metaperiodate (pH 6.4) showed that one mole of the synthetic sample consumes 1.1 mole of sodium metaperiodate. Under identical conditions glucose consumes 5.3 moles of periodate. Since the formation of veratraldehyde and phloroglucinaldehyde dimethylether needs the consumption of 2 moles of periodate, it can be concluded that the oxidation with an aqueous solution of sodium metaperiodate stops at the first stage, i.e., with the formation of a dialdehyde. The product is definitely different from veratraldehyde or phloroglucinaldehyde dimethylether. The new aldehyde has been isolated as its oxime since the preparation of a 2, 4-dinitrophenylhydrazone would involve objectionably high acid concentrations. The mass spectrum of the oxime has been studied. The molecular ion peak of the oxime could not be obtained though the spectrum had peaks up to 368. The presence of peaks beyond 200 obviously rules out the simpler aldehydes mentioned above. Significant among the mass peaks is the peak at 353 which can be attributed to $M - (2H_2O + H)$ (II). Nitrogen estimation of the oxime shows it to be a

dioxime. Hence Structure I could be assigned to the aldehyde.



EXPERIMENTAL

An aqueous solution of sodium metaperiodate (20 ml.; 2.503 g./250 ml.) is added separately to each of the following in aldehyde-free ethanol (30 ml.): (a) leucocyanidin methyl ether (0.025 g.), (b) analar glucose (0.025 g.) and distilled water (3 ml.), and (c) blank. After keeping the solutions for 48 hours a standard solution of arsenious oxide is added to each with shaking and allowed to stand for half an hour, excess of arsenious oxide was determined iodimetrically. From the amount of arsenious oxide the amount of periodate consumed has been calculated and given below:

Compound	Glucose	Blank	Leucocyanidin methyl ether
Moles of Periodate consumed	5.3	Nil	1.1

Isolation of the dioxime.—An aqueous solution of sodium metaperiodate (50 ml.; 2.503 g./250 ml.) is added to a solution of leucocyanidin methyl ether (0.1 g.) in aldehyde-free ethanol (100 ml.). After keeping the homogeneous solution for 48 hours, it was diluted and extracted repeatedly with ethyl acetate. The ethyl acetate extract was thoroughly washed with a saturated solution of bicarbonate and finally with water and dried over anhydrous magnesium sulphate. Removal of the solvent gave a semi-solid residue. It was taken up in alcohol and treated with hydroxylamine hydrochloride in presence of sodium acetate. The oxime crystallised from ethanol as colourless rods, m.p. 214–16° (Found N_2 , 8.2%; $C_{19}H_{22}O_7N_2$ requires N_2 , 7.2%).

Department of Chemistry, V. KRISHNAMOORTHY.
University of Delhi, T. R. SESHADRI.
Delhi-7, December 9, 1965.

STUDIES ON THE USE OF BRUCIQUINONE AS A NEW ACID-BASE INDICATOR

BRUCIQUINONE, the red oxidation product of brucine, shows a pink colour in acid solutions and a yellow in alkaline solutions.

Our investigations have shown that this substance serves as a good acid-base indicator. The results obtained are reported below:

Bruciquinone is obtained by the method of Leuchs, Seeger and Jaegers¹ by oxidation with cold 5 N nitric acid and isolated as its perchlorate. A 0.5% stock solution of the substance is prepared by triturating in an agate mortar 0.5 g. of the solid with the calculated quantity of sodium hydroxide and the solution is made up to 100 ml. This stock solution is found to be stable for a long time but at the end of four weeks it leaves a sediment on the walls of the container. The indicator action of the substance is, however, not affected by this.

The transition interval of the indicator is measured by noting the colour of the indicator in a series of buffer solutions of varying pH values. Such studies have shown that the transition of the indicator takes place over a pH interval of 8.1 to 9.2. Two drops (0.1 ml.) of the 0.5% indicator solution present in 40 ml. of the titrating mixture are found to give a satisfactory colour change in a regular titration and the indicator correction corresponding to this concentration of the indicator is found to be equivalent to 0.05 ml. of 0.1 N sodium hydroxide.

The applicability of the indicator in regular acid-base titrations is studied by carrying out a large number of titrations between (i) strong acid and strong base, (ii) weak acid and strong base and (iii) strong acid and weak base. While the first two gave excellent results (correct to one drop decinormal solution) with sharp end points, the strong acid-weak base titration gave erroneous values. This is understandable as the transition interval of the indicator lies between pH values of 8.1 and 9.2.

As the colours of the indicator on the acid and basic sides have overlapping spectra, we considered it worthwhile to modify the indicator with a blue dye in order to improve the colour change. Copper phthalocyanine tetrasulphonate (potassium salt) formerly employed by Sastry and Pratt² is found to be very useful in this regard. A sample of the dye kindly supplied by Messrs. Dupont De Numours and Company is used in our investigations. The

1. Jackson, E. L., in *Organic Reactions*, Edited by Roger Adams, John Wiley & Sons, Inc., New York, 1947, 2, 341.
2. Ganguly, A. K. and Seshadri, T. R., *J. Tetrahedron*, 1959, 6, 21.
3. King, F. E. and Bottomley, W., *J.C.S.*, 1954, p. 1399.
4. Nagarajan, G. R. and Seshadri, T. R., *Curr. Sci.*, 1960, 29, 178.
5. Drewes, S. E. and Roux, D. G., *Chem. Ind.*, 1963, p. 532.

in the form of a cylinder, to iodine vapour in a closed jar for 2 to 3 minutes. The unsaturated acids appear as brown spots on a pale yellow background. (The unsaturated acids can also be located, along with the saturated acids, by immersing the chromatogram in 0.2% copper acetate solution, washing with water, drying, and dipping in 0.03% dithio-oxamide in 95% ethanol.)

The chromatogram of the unsaturated acids from the common oils and from sesame oil admixed with 5% mustard oil and castor oil, respectively, are illustrated in Fig. 1. The un-

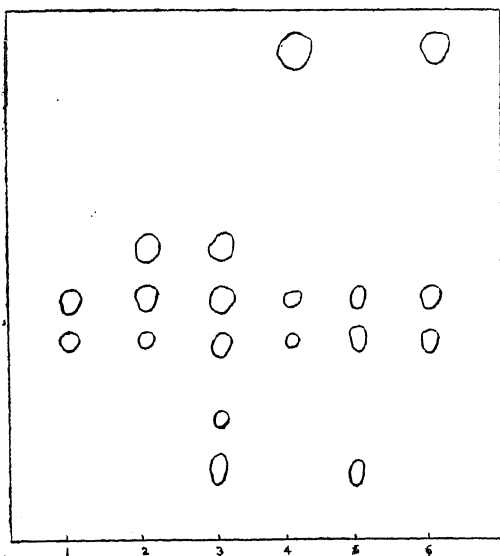


FIG. 1. Chromatograms of the unsaturated acids of common vegetable oils. (1) Sesame, groundnut, cottonseed, safflower, coconut and mahua oils. (2) Linseed oil. (3) Mustard oil. (4) Castor oil. (5) Mixture of Sesame and Mustard oils (95:5). (6) Mixture of Sesame and Castor oils (95:5).

saturated acids of sesame oil, groundnut oil, cottonseed oil, safflower oil, coconut oil and mahua oil separated into two zones with R_f values 0.38 and 0.46, the intensity of the zones varying with the oleic and linoleic acid content of the oils. Linseed oil gives rise to three spots with R_f values 0.38, 0.46 and 0.54. In the case of mustard oil five unsaturated acids are distinguishable, with R_f values 0.14, 0.23, 0.38, 0.46 and 0.54, the spot with R_f value 0.14, due to erucic acid, being very marked. Castor oil shows three spots, those with R_f values 0.38 and 0.46 being faint and that with R_f value 0.94, due to ricinoleic acid, being conspicuous.

The zone with R_f value 0.14 is characteristic of mustard oil. It is not given by any other oil, but is obtained when 5% of mustard oil is

present in any other oil. Similarly the zone with R_f value 0.94 is peculiar to castor oil. It is absent in the case of the other oils, but is clearly distinguishable when 5% or even less of castor oil is present in any other oil.

The method offers a simple and reliable means of identifying mustard oil and castor oil when admixed with other vegetable oils.

We thank Sri. K. Narayanaswamy, Government Analyst, for permission to carry out this study.

Government Analyst's P. S. NATARAJA SARMA.

Laboratory, V. V. NITHYANANDAN.

Madras, November 12, 1965.

A NOTE ON THE RELATIONSHIP OF BUNDELKHAND GNEISS OF RAJASTHAN WITH THE SURROUNDING SEDIMENTS *

A. M. HERON considered the granite occurring in the area adjacent to the Berach river in the Bhilwara and Chittorgarh districts of Rajasthan as the basement over which the surrounding Aravalli rocks were deposited. Based on the physical and mineralogical resemblance, he correlated this granite with that of the Bundelkhand area in Uttar Pradesh and thus, referred to it as "Bundelkhand Gneiss" in his publications. B. C. Gupta, who mapped the eastern part of the area, where the granite is exposed, agreed with Heron. E. H. Pascoe referred to this granite as Berach Granite.

The granite is generally medium to coarse-grained, equigranular with pink feldspars (orthoclase and microcline), albite, perthite, opalescent quartz and a few grains of biotite or hornblende. Epidote, magnetite and apatite are the minor accessories. At the contact with the quartzites, at places, a larger proportion of irregular grains of quartz are seen in the granite. Near the contact with slates, the rock becomes greenish and is enriched in chlorite. Gneissic foliation is common towards west, where it is noticed to merge with the gneisses.

The exact contact of the granite with the quartzites is exposed at a few places and these have been interpreted as sedimentary by Heron. Closer examination reveals sinuous and irregular contacts, the orthoquartzites showing enrichment feldspar at the contact with the granite thus becoming friable there. Near Putholi, north of Chittorgarh, the granite has eaten up a part of the quartzite and the contact is highly irregular. Thin strips of quartzite are also seen in the granite. Further west, a number of xenoliths of slates are noticed in the

granite. Just west of Bara Khera, the 1 m to 2 m thick vitreous quartzite band has tongues, veins and veinlets of granite clearly indicating the intrusive nature of the latter. The contact with the slates is generally covered but in the few exposures available, the shales and slates show puckering, hardening, silicification and feldspathisation near the contact. Very good gradational contacts between granite and feldspathised slates are seen in the bed of the Berach river north of Bilor, in the bed of the Banas north of Magrop and in the Bagan river where the Udaipur-Chittorgarh road crosses it. At the latter place, the granite is enriched in chlorite and calcite and much metasomatic replacement is indicated. Thin aplitic bands are also seen in the slates at the contact there.

On a regional scale the boundary of granite is very irregular and it comes into contact with the different members at different places. Tongue-like extensions of granite near Amlī, Kalias, Bhawanipura and Det can be better explained if the granite is intrusive. Much recrystallisation of quartzites near Mataji-kā-Khera and occurrence of granite in the core of the structure there, also suggests the intrusive nature.

Absence of contact metamorphism has been quoted by Heron, as an evidence for considering the Bundelkhand gneiss as the basement. Similar is the case with the sediments around the post-Aravalli granite near Udaipur, which is undoubtedly intrusive. Probably, this is due to lack of volatiles as evidenced by dearth of pegmatites in the area. Silicification and feldspathisation seen in the quartzite and shales at places around the Bundelkhand gneiss are definitely the effects of intrusion.

Thin pebble bands extending over short distances in the different orthoquartzites have been considered to indicate unconformity. About 1.5 km. west of Barliās, there is a 2 m thick vitreous, buff quartzite which was considered by Gupta to be the basal conglomeratic bed of the Aravallis. The quartzite is generally free from feldspar, and at only one place a 2 m long and 0.5 m deep channel, with small well-rounded pebbles, is seen. The quartzite is recrystallised and at the contact with the granite small feldspathised patches are also seen. Similarly most of the conglomerates, referred to by Heron, are interbedded and a few are channel fillings. As already mentioned, the granite is in contact with the different quartzite and slates and it is rather difficult to interpret all of them as basal.

Heron himself emphasised the absence of any special marginal deposit characteristic of an

erosional unconformity in this area. Further, he cites evidences of intrusive contacts but considers them to be due to close wedge-faulting or deposition of sediments on a highly irregular surface of the granite.

Recent mapping of the area has convinced the authors that the Bundelkhand Gneiss of Rajasthan is intrusive into the shales, slates and quartzites which are nothing but the westward extension of rocks referred to as Gwalior by Heron. As evidenced by the equigranular texture, some shearing and development of foliation, the granite appears to be late to post-tectonic. North-east of this area, near Jahazpur, the Gwalior rocks have been metamorphosed and granitised yielding the Banded Gneissic Complex. Further west of the Gangrar-Hamirgarh quartzite ridge also, extensive granitisation is observed. It is therefore likely that the Bundelkhand Gneiss is an intrusive phase of the major granitic activity in the area. The relationship of the Bundelkhand Gneiss of Rajasthan with that of the granodiorites of U.P., which are also intrusive into the sediments there (A. G. Jhingran, 1958), cannot be established until absolute age determinations are made.

Geological Survey of India,
Rajasthan Circle,
Jaipur, August 24, 1965.

C. S. RAJA RAO.
IQBALUDDIN.

* Published by permission of the Director-General, Geological Survey of India.

1. Heron, A. M., 'Synopsis of the pre-Vindhyan geology of Rajputana,' *Trans. Nat. Inst. Sci. Ind.*, 1935, 1 (2), 17.
2. —, 'The Geology of S. E. Mewar, Rajputana, *Mem. G.S.I.*, 1936, 68, pt. 1.
3. Gupta, B. C., 'The Geology of Central Mewar,' *Ibid.*, 1934, 65, pt. 2.
4. Jhingran, A. G., 'Presidential address,' *Proc. 45th Ind. Sci. Cong.*, 1958.
5. Pascoe, E., *A Manual of the Geology of India and Burma*, 1950, 1.

A NOTE ON SUCCINIC DEHYDROGENASE ACTIVITY OF TISSUES OF THE COMMON FRESH- WATER MUSSEL, *AMALANES* *MARGINALIS*

THE respiratory enzymes of freshwater pelycypod, *Amalanes marginalis* have not been studied so far.¹ While investigating the effects of temperature acclimation on the respiration and ciliary activity in this animal, it was felt that a study of a seemingly ubiquitous enzyme like succinic dehydrogenase would be of interest. The present note deals with the activity of this

dye is stated to be 87.3% pure and we have found that a mixture containing 0.75 ml. of 0.1% dye solution for every 5 ml. of the 0.5% bruciquinone indicator solution gives a sharp colour change from deep pink to green. One drop of this mixture is found to be sufficient for every 40 ml. of the titration mixture in contrast to 2 drops required when bruciquinone alone is employed as indicator.

Department of Chemistry, T. P. SASTRY.
Regional Engineering College, P. S. SASTRY.
P.O. Kazipet, July 27, 1965. M. RAMAIAH.

1. Leuchs, H., Seeger and Jaegers, K., *Ber.*, 1938, 71 2023.
2. Sastry, T. P. and Samuel Pratt III, *Z. anal. Chem.*, 1960, 175, 182.

TETRANITROAZOXYBENZENE AND PHOTOINDUCED CONDENSATIONS OF POLYNITROAROMATICS

STENBERG and HOLTER¹ recently have reported the formation of 3, 5, 3', 5'-tetranitroazoxybenzene (I) by irradiation of 1, 3, 5-trinitrobenzene in ethanol and tetrahydrofuran. They have stated that photo-chemical condensations of polynitroaromatic compounds have not been reported earlier and that (I) was prepared with difficulty by a non-photochemical method.²

Photochemical decomposition of polynitroaromatic compounds leading to the formation of azoxy derivatives through intermediate nitroso compounds has already been reported.^{3,4} The formation of a dicarboxy derivative of 3, 5, 3', 5'-tetranitroazoxybenzene (II) itself has also been reported by the present authors,⁵ by the photochemical condensation of 2, 4, 6-trinitrobenzaldehyde with an intermediate formation of 2, 4-dinitro-6-nitrosobenzoic acid. The identity of 2, 2'-dicarboxy-3, 5, 3', 5'-tetranitroazoxybenzene with the "white compound" formed as a by-product in a continuous TNT manufacture has also been reported. 3, 5, 3', 5'-tetranitroazoxybenzene can be obtained without any difficulty in a good yield by the procedure described below:

10 g. of (II) was refluxed with 100 ml. of pyridine on a sand-bath for 1.5 hours. The black mixture was poured in water and acidified with dil. H_2SO_4 . The black residue was filtered and washed free of acid. After washing, the residue was dried and extracted with boiling toluene with addition of little animal charcoal. The toluene extract on cooling gave pink-coloured needles of (I). Final crystallisation was from acetic acid.

Yield—5 g., m.p. 190°.

Anal. calcd. for $C_{12}H_6N_6O_9$: Mol. wt., 378, N, 22.22.

Found: Mol. wt., 376, N, 22.26.

Explosives Research and W. D. PATWARDHAN,
Development Laboratory, S. A. JOSHI.
Kirkee, Poona-3, July 3, 1965.

1. Stenberg, V. I. and Holter, D. J., *J. Org. Chem.*, 1964, 29, 3420.
2. Lobry De Bruyn and van Leent, A., *Rec. Trav. Chim.*, 1894, 13, 148.
3. Bamberger and Elger, *Ann.*, 1910, 371, 319.
4. Patwardhan, W. D., *Defence Sci. Jour. India*, 1964, 4, 67.
5. Joshi, S. A. and Patwardhan, W. D., *Curr. Sci.*, 1963, 22, 239.

PROTEOLYTIC ACTIVITY OF SOME PLANT LATEX (Effect of Time Variation)

In a previous communication¹ we reported the proteolytic activity of fourteen samples of latex collected from different families and species of plants. The pH optima for five of these latices available in appreciable quantities were also determined by employing different buffers at various pH. As a result it was observed that the latices of *Calotropis gigantea* and *Carica papaya* have 6 as their pH optima. In addition, it was found that the latices of *Calotropis procera* and *Cryptostegia grandiflora* exhibited two distinct peaks of activity each at pH 4 & 8 and 5 & 7 respectively. The existence of these two peaks at different pH led us to suggest the presence of two components possessing proteinase activity. The foregoing describes the effect of time variation on the proteolytic activity of five samples tested previously at pH 7.

Materials.—Fresh latex was collected from different plants having healthy vigorous growth. Leaves and tender shoots were nipped and the oozing milky sap was allowed to drain in clean dry tubes kept immersed in salt-ice mixture. In cases where yield of latex was scanty, collection was made from more than one plant growing in the neighbourhood and pooled. The best time for collection was found to be early morning before sunrise when the plants were quite turgid and afforded the maximum yield of latex.

Determination of Proteolytic Activity.—Proteolytic activity was measured as described by Yamafuji and Yoshihara.² The amount of tyrosine released was estimated by the method of Lang and Wegner³ as described by Turba.⁴ A known volume (0.5 ml.) of latex was diluted to 2 ml. with sodium carbonate (0.2 N)

followed by the addition of 2 ml. each of casein solution (2%, w/v, prepared as described by Balls and Lineweaver⁵) and phosphate buffer at pH 7. The mixture was well stirred and incubated at 37–38° for the desired length of time. After incubation the reaction was stopped by the addition of trichloroacetic acid (4 ml., 0.25 M), allowed to stand for 10 minutes at room temperature and then spun. The precipitated undigested protein was discarded and proteolytic activity was determined in the clear supernatant.

0.1–1.0 ml. of the supernatant was diluted to 2 ml. with distilled water and α -nitroso- β -naphthol in ethanol (0.05 ml., 1 mg.%, w/v) was added to it followed by a solution of ferric ammonium sulphate (2 ml., prepared by mixing 5 parts of saturated solution of ferric ammonium sulphate and 1 part of concentrated nitric acid, sp. gr. 1.42). The mixture was carefully brought to boiling and allowed to stand for one hour at room temperature. The colour developed was read in a Bausch and Lomb Spectronic 20 colorimeter at 400 m μ against a blank identically treated from the supernatant of the control. The amount of tyrosine released was calculated from a calibration curve prepared earlier by measuring the optical density of standard tyrosine at different concentrations. The proteolytic activity was expressed in terms of mg. of tyrosine liberated by 100 mg. of latex at pH 7.

The results obtained as represented in Fig. 1 evince that of the five latices tested, the latex

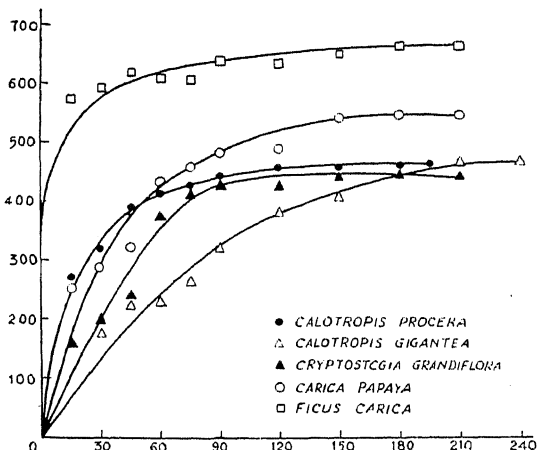


FIG. 1. Effect of time variation on the proteolytic activity of plant latices.

of *Ficus carica* possesses the maximum activity, the optimum being 45 minutes. In the case of *Calotropis procera*, *Cryptostegia grandiflora*, *Carica papaya* and *Calotropis gigantea* the

optimum time observed was 75, 120, 150 and 210 minutes respectively.

Our thanks are due to the Council of Scientific and Industrial Research, New Delhi, India, for financial assistance and a research assistantship to one of us (S. C. S.).

Biochemistry Section,
The University,
Allahabad, July 27, 1965.

RADHA PANT.
S. C. SRIVASTAVA.

1. Pant, Radha and Srivastava, Subhash, C., *Hoppe Seyler Z.*, 1964, **338**, 52.
2. Yamafuji, K. and Yoshihara, F., *Enzymologia*, 1960, **22**, 157.
3. Lang, K. and Wegner, E., *Biochem. Z.*, 1948, **318**, 462.
4. Turba, F., In *Hoppe-Seyler Thierfelder, Handb. d. Physiol.-und pathol.-chem. Analyse*, Springer-Verlag, Heidelberg, Bd. III/2, 1955, p. 1742.
5. Balls, A. K. and Lineweaver, H., *J. biol. Chem.*, 1939, **130**, 669.

IDENTIFICATION OF MUSTARD OIL AND CASTOR OIL IN OTHER OILS BY PAPER CHROMATOGRAPHY

In examining edible oils for adulteration, the analyst is sometimes called upon to identify the constituents of a mixture of oils. Specific identification tests are available only for sesame oil and cottonseed oil. The presence of other oils can only be inferred from a collation of analytical data such as the refractive index, iodine value, Bellier test, etc. Mustard oil and castor oil differ from other oils in that they contain the unsaturated fatty acids, erucic acid and ricinoleic acid respectively. We have found that separation of these acids by reverse phase chromatography and their identification with iodine offers an easy and reliable method of identifying mustard oil and castor oil when present to the extent of 5% or more in other oils. The method we have used is briefly reported below.

The mixed fatty acids are prepared as in the well-known titre test. Strips of Whatman No. 4 paper, 25 cm. \times 25 cm., are prepared by dipping them through a solution of 10% liquid paraffin in ether and drying in air. About 50 microgram of the mixed fatty acids in the form of a chloroform solution is spotted. We have used the ascending technique. After trials with various solvent combinations, the following solvent, not so far reported, was found to be well suited for routine analysis: Acetic acid 6, water 2, amyl acetate 2, saturated with medicinal liquid paraffin. Satisfactory separation results in about 16 hours. The developed chromatogram is air-dried and the unsaturated fatty acids are located by exposing the paper, rolled

enzyme in different tissues. This was studied by the reduction of triphenyltetrazolium chloride to a red water-insoluble formozan using sodium succinate as substrate.² All the experiments were performed at a temperature of 25°C. The resulting formozan at the end of one hour was extracted with acetone and read at 420 m μ in a Lumetron colorimeter. The optical density is directly proportional to the enzyme activity. The results are given in Table I.

TABLE I

Tissue	μ g. of dye reduced / mg. of tissue / 60 min.				
	Mussel 1	Mussel 2	Mussel 3	Mussel 4	Mean
Heart	1.15	0.915	1.412	0.905	1.09
Gill	0.404	0.380	0.452	0.615	0.46
Foot	0.325	0.235	0.742	0.478	0.45
Adductor					
Muscle	0.381	0.331			0.36
Viscera	0.298	0.205	0.272	0.187	0.23
Mantle	0.160	0.126	0.332	0.213	0.21

A perusal of Table I would clearly show that the heart tissue (including pericardium) shows maximum activity. The activity of the other tissues in decreasing order is as follows:

Heart > Gill > Foot > Adductor muscle > Viscera > Mantle. The results obtained in the present study when compared with values reported for heart of rat² using this method shows that the activity is very low in *Lamellidens*. In rats, the dehydrogenase activity of the heart tissue is nearly 3.6 times that of *Lamellidens*. This may be correlated perhaps with low metabolic rate in a more or less sedentary mussel compared to an active homeotherm like the rat. Further, the temperature may accelerate the activity in rat.³ Among the various tissues, the kidney shows the maximum activity in the rat whereas it is the heart in *Lamellidens*. *Lamellidens* shows very little muscular activity except in the heart, gills and foot. Perhaps this is reflected in the succinic dehydrogenase activity also.

Department of Zoology, S. KRISHNASWAMY,
University of Madras, A. L. PAULPANDIAN,
Madurai Centre, Madurai-2,
August 5, 1965.

1. Bliss, D. E. and Swinner, D. M., *Tissue Respiration in Invertebrates*. The American Museum of Natural History, New York, 1963.
2. Kun, E. and Abood, L. G., "Dehydrogenase by Triphenyltetrazolium chloride," *Science*, 1949, 109, 144.
3. Vroman, H. F. and Brown, J. R. C., "Effect of temperature on the activity of succinic dehydrogenase from the livers of rats and frogs," *J. Cell. comp. Physiol.*, 1963, 61, 129.

MULTICELLED TRABECULAE IN SOME SPECIES OF *SELAGINELLA*

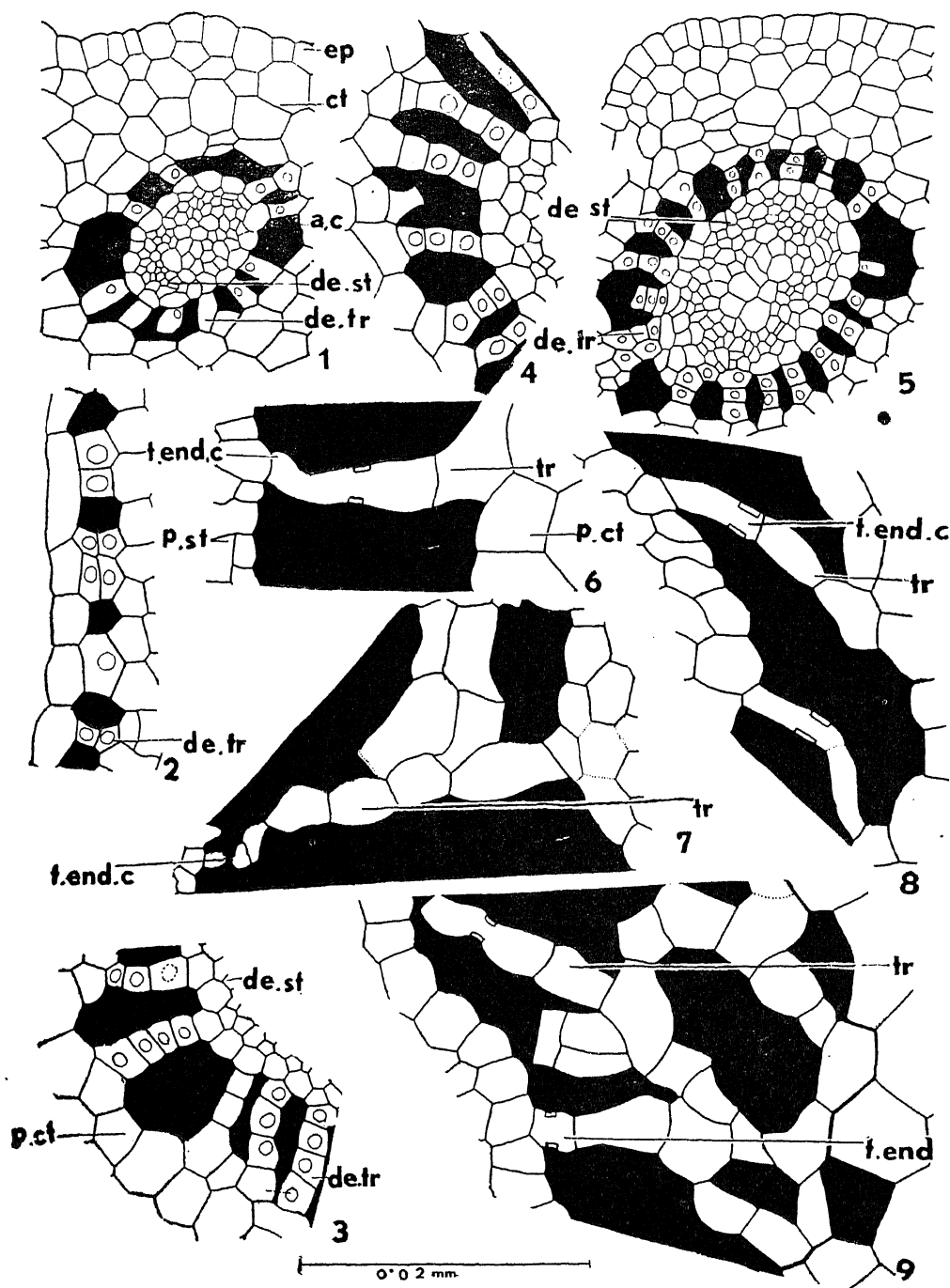
A TRABECULA in case of *Selaginella* stem has usually been described as unicellular structure (see Barclay,¹ Eames,² Smith³). Further, it is usually believed to represent the endodermal layer of *Selaginella* stem. Figures in literature show casparian strips in them. Webster's⁴ dictionary has defined a trabecula, on the other hand, as 'a row of cells bridging an intercellular space'.

During the study of apical organization and differentiation⁵ of tissue in some species of *Selaginella*, i.e., *S. tamariscina* (Beauv.) Spring; *S. remotifolia* Spring; *S. adunca* A. Br.; *S. monospora* Spring; *S. chrysorrhizos* Spring and *S. sp.*, trabeculae were found consisting of more than one cell in young stem as well as in mature except in *S. chrysorrhizos* where they are unicellular from the very beginning. This necessitated a detailed study of the structure and developmental aspects of trabeculae in all these species.

In *S. chrysorrhizos* during differentiation, some cells of the inner tissue, surrounding the stele in the central apical region just below the apical meristem, begin to elongate in both fertile and sterile apices (Fig. 1). At a slightly lower level, these elongated cells of the procambial strand are further differentiated from the surrounding tissue of the cortex. It is due to the development of the several intercellular spaces surrounding the central core as observed in cross-sections (Fig. 1). The spaces are formed schizogenously. Each elongated intervening cell which is present in between the two spaces is one cell in width, height and length. It undergoes radial extension and forms a trabecula. Each trabecula later on develops a casparian strip in its central region.

In all other species, however, they are two to several cells in length though one cell in width and height from the very beginning (Figs. 3, 4 and 5). It is significant to note that such a situation has not been reported in any earlier work on this genus.

In mature stems the trabeculae are not visible usually either due to their delicate nature or due to their complete rupture. Occasionally they have, however, been observed showing variation in structure in different species and even in the same from their initial condition during differentiation. It appears, therefore, worthwhile to study their structure in young as well as in old stems in some detail. In *S. tamariscina*, in the beginning they are four



FIGS. 1-9. Fig. 1. A portion of a transverse section of young stem of *S. chrysorrhizas* showing differentiating trabeculae. Fig. 2. A portion of a longitudinal section of young stem of *S. tamariscina* showing differentiating trabeculae and air spaces. Figs. 3-5. Portions of transverse sections of young stems of *S. tamariscina*, *S. remotifolia* and *S. monospora* respectively showing differentiating trabeculae and air spaces. Figs. 6-9. Portions of transverse sections of mature stems of *S. sp.*, *S. remotifolia*, *S. monospora* and *S. tamariscina* respectively showing mature trabeculae connecting stelar tissue with the cortex. Note the presence of casparian strips only in one cell which is adjacent to the pericycle. (a.sp., air space; ct., cortex; de.st., differentiating stele; de.tr., differentiating trabecula; p.st., part of the stele; p.ct., part of the cortex; t.end.c., true endodermal cell; tr., trabecula.)

to seven cells in length (Figs. 2 and 7) but as their course is followed further in cross-sections, the inner cortical cells which are just adjacent to the trabeculae also develop intercellular spaces and thus an irregular mass of tissue is formed between the outer cortex and the stele of the stem (Fig. 9). In older stems of this species they are completely missing or when present are multicellular (Fig. 9). In case of *S. remotifolia* they are multicellular in young as well as in mature stems (Figs. 4 and 7). In *S. monospora* in one trabecular cell two degenerated nuclei have been observed without any trace of partition wall. It, therefore, indicates that unicellular condition in some species might have been attained by the dissolution of the partition walls between two trabecular cells (Fig. 8). In *S. sp.* they sometimes give the appearance of a single cell connecting the cortex with one or two cells on one side and the stelar tissue on the other (Fig. 6). It must be pointed out here that whenever a multicellular trabecula has been observed in mature stems, the casparian strip has been found only in one cell which is adjacent to the pericycle (Figs. 6-9).

From the preceding account, it becomes clear that a trabecula may be unicellular or multicellular in young as well as in mature stems. However, if this turns out to be a usual condition (other species being investigated), we have to broaden our notion about the morphology of the trabeculae. The usual concept that they are endodermal in nature would have to be modified, as true endodermis is rarely more than one layer thick; *Equisetum* and *Lygodium* root being only exception where it is two layers thick. Thus on the basis of the present work, it can be said that trabecula in case of *Selaginella* is partly endodermal, as the casparian strip develops only in one cell whenever a multicellular trabecula has been observed, and partly cortical in origin at least in those species where a multicelled condition is found in young as well as in mature stems. The multicelled condition of trabeculae appears to be correlated with the nature of the air space system in the stem of *Selaginella*. If the air space system is large, a trabecula is made up of several cortical cells in addition to an endodermal cell.

The author is grateful to Professor V. Puri for his valuable suggestions and to Prof. A. B. Gupta, Christ Church College, Kanpur, for providing necessary facilities to complete this work.

School of Plant Morphology,
Meerut College,
Meerut, June 25, 1965.

S. BHAMBIE.

1. Barclay, B. D., *Bot. Gaz.*, 1931, **91**, 452.
2. Eames, A. J., *Morphology of Vascular Plants*, 1936.
3. Smith, G. M., *Cryptogamic Botany*, 2nd Edition, 1955, 2.
4. Fuller, S., *Webster's New International Dictionary*, 2nd Edition, 1957, 2.
5. Bhambie, S. and Puri, V., *Memoir, Indian Bot. Soc.*, 1963, **4**, 54.

IN VITRO CULTURE OF UTRICULARIA

THE insectivorous plants have curiously modified leaves to capture the prey. Whether the trapping of the prey is a mere consequence of the structural modifications or the plants depend on the prey for a part of their nutrition is a fundamental question. What morphogenetic factors control the development of the trapping structures is also worthy of inquiry. Such problems can best be studied by cultivating the plants on defined nutritive media under controlled environmental conditions.

The first report of the aseptic culture of an insectivorous plant concerns *Drosera* (Burger, 1961). Pringsheim and Pringsheim (1962) raised sterile cultures of *Utricularia exoleta* and got them to flower after the addition of peptone and beef extract to the medium. Harder (1963) obtained flowering in this species by including into the medium peptone extract from meat or infusions of *Daphnia*. Another recent study is that of Withner (1964) on *Darlingtonia*, *Dionaea* and two species of *Sarracenia*. Harder (1964) was able to make cultured plants of *Drosera pygmaea* flower, fruit and complete their life-cycle without the addition of animal proteins into the medium.

The present work consists of preliminary observations on the germination of the seed and the development of the adult plant of *Utricularia gibba* Linn. sub sp. *exoleta* (R.Br.) Taylor.* The formative effects of some growth-regulating substances have also been studied.

The fruits of *Utricularia*, collected from Bangalore in July 1964, were surface-sterilized with chlorine water. The seeds were dissected out aseptically and planted on White's basal medium (WB) with 2% sucrose. For later studies the medium was supplemented with one of the following: naphthaleneacetic acid (NAA, 1 and 5 ppm), 2,3,5-triodobenzoic acid (TIBA, 1 and 5 ppm); gibberellic acid (GA, 5 and 10 ppm); coconut milk (10% v/v), 2,4-dichloro-

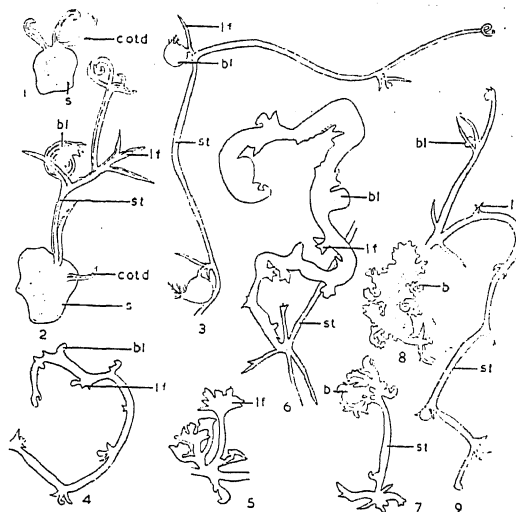
phenoxyacetic acid (2,4-D, 5 ppm), indoleacetic acid (IAA, 1 ppm), kinetin (1 ppm), beef extract (400 ppm), tryptone (400 ppm) and casein hydrolysate (400 ppm). In a mature seed the embryo is totally unorganized; it has neither root and shoot primordia nor cotyledons. However, it has a growth pole from which the primary organs arise during germination.

Seventy per cent. of the seeds germinated on WB after 24 days. During germination three or four 'cotyledonoids' (Llyod, 1942) made their appearance at the growth pole. Of these one (sometimes more) developed into a stolon (Figs. 1, 2). The latter produced a series of alternately arranged dissected leaves. The first bladder made its appearance 8-10 days after germination. A semi-solid medium proved better for germination but the rate of growth of the seedlings was faster in liquid medium. The seedlings were transferred to a fresh liquid medium and later propagated by cuttings.

After the plants filled out the liquid medium, filamentous growth occurred at the surface or along the walls of the container (Fig. 3). Aerial branches grew above the surface and bore bladders which were free of hairs. Bits of the stolon were transferred to tubes containing various growth-regulating substances to study their morphogenetic effects. NAA was found to be toxic at 5 ppm. At a concentration of 1 ppm, the development of the bladders became arrested and the leaves remained stunted (Fig. 4). The anatomy of the stolon showed a marked reduction in the number of air chambers and the development of a few thick-walled cells in the central cylinder. On TIBA (1 and 5 ppm) the leaves and stems became fasciated (Fig. 5). GA (1 and 5 ppm) was markedly inhibitory to bladder development. The freshly grown parts showed elongated leaves which were free of bladders. The internodal length, however, remained unchanged. On 2,4-D (5 ppm) the apex of the stolon became highly flattened and the bladders were inhibited. The addition of coconut milk to the 2,4-D medium increased the effects of the latter (Fig. 6).

Kintein (1 ppm) stimulated a proliferation of the cells at the nodes and internodes and the production of buds at the nodes (Figs. 7, 8). The addition of IAA (1 ppm) to kinetin had no particularly stimulative effect. IAA (1 ppm), when used alone, brought about a shortening of the internodes and leaves and the bladders did not develop to their full size (Fig. 9).

Tryptone and beef extract accelerated the rate of vegetative growth and bladder development. On WB alone, the bladders tended to abscise after a few days growth. Tryptone and beef extract favoured their retention. What role proteins have in abscission is not clearly understood.



FIGS. 1-9. Figs. 1-2. Germination of the seed on WB (agar). Figs 3-9. Formative changes induced by growth-regulating substances. Fig. 1. Germinating seed with three 'cotyledonoids'. Fig. 2. Young seedling with leaves and a bladder. Fig. 3. Portion of a mature plant cultured in liquid medium (WB). Fig. 4. Effect of NAA (1 ppm) on the growth of the shoot. The leaves are stunted and the bladders are arrested in development. Fig. 5. Highly expanded fan-shaped leaves in WB+TIBA (5 ppm). Fig. 6. Portion of shoot showing abnormal modification on WB+2,4-D (5 ppm) + CM (10% v/v). Figs. 7-8. Kinetin-induced effects. Note callusing of the nodes and emergence of buds. Fig. 9. Growth on WB+IAA (1 ppm). The leaves are short and the bladders are poorly developed. (All figs., $\times 6$.) (b, bud; bl, bladder; cotd, cotyledonoid; lf, leaf; s, seed; st, stolon.)

The cultures have been maintained in an active state of growth by repeated subculture for the past eight months. In spite of the addition of animal proteins like tryptone, beef extract and casein hydrolysate to the medium and exposure of cultures to varying daylight conditions, flowering has not been induced so far.

Further work on the nutrition and morphogenesis in the cultures of *Utricularia* is in progress.

We are indebted to Professor P. Maheshwari for his interest and counsel and to Dr. R. N. Chopra and Mr. P. S. Rao for their help.

Department of Botany, H. Y. MOHAN RAM.
University of Delhi, SHIPRA DUTTA.
Delhi-7, India, July 21, 1965.

* This plant has been referred to in literature as *Utricularia exoleta* R.Br. but has been changed to *U. gibba* Linn, sub sp. *exoleta* (R.Br.) Taylor (Taylor, 1963).

1. Burger, R. M., *Nature (Lond.)*, 1961, **191**, 724.
2. Harder, R., *Planta*, 1963, **59**, 459.
3. —, *Ibid.*, 1964, **63**, 316.
4. Llyod, F. E., *The Carnivorous Plants*, Waitham, Mass., 1942.
5. Pringsheim, E. G. and Pringsheim, O., *Amer. J. Bot.*, 1962, **49**, 898.
6. Taylor, P., *Kew Bull.*, 1963, **18**, 197.
7. Withner, C. L., *Bull. Torrey bot. Cl.*, 1964, **91**, 412.

THE RICE COLEOPTILE STRAIGHT GROWTH TEST FOR AUXIN BIOASSAY

BIOASSAY of auxin using oat coleoptile straight growth test introduced by Bonner¹ has since been worked out by several authors^{2,3,4} under different conditions and using different oat varieties. A few investigations^{3,5} have also shown that wheat coleoptile could successfully be employed for the biological assay of auxin. However, it is desirable to investigate the suitability of other plants for auxin bioassay not only from the standpoint of finding more sensitive material but also in view of their ready availability. The present work therefore, attempts to find out whether the locally readily accessible rice plant could be adopted for the coleoptile straight growth assay of auxin.

A cultivated variety of rice (*Oryza sativa*, L. var. MTU-20) was selected for the investigation. The seeds were washed under the tap followed by distilled water and were surface sterilized by a rapid rinsing in rectified spirit. They were then washed with glass distilled water and soaked in the same overnight in darkness. The soaked seeds were sown on wet filter paper in 6" petri dishes in a dark room maintained at 24° to 26° C. and growth was allowed for 60 hours. The average length of the coleoptiles by then was about 1.5 to 2.0 cm.

After 60 hours germination the coleoptiles were decapitated in diffuse light by discarding the 3.0 mm. portions from the tops. The next 4.0 mm. sections were used for the bioassay. The range of concentration of Indole-3-acetic acid (IAA) tried was from 10^{-9} M to 10^{-3} M made up in 2.0% unbuffered sucrose. Ten coleoptile segments each were floated on 2.0 ml solution of 2.0% unbuffered sucrose for control and 2.0 ml of IAA solutions in watchglasses

and were incubated in darkness at 24°–26° C. After 18 hours incubation the length attained by the coleoptile segments was measured under a binocular microscope using mm. graph paper. The experiment was repeated 4 times. The result is shown in Fig. 1.

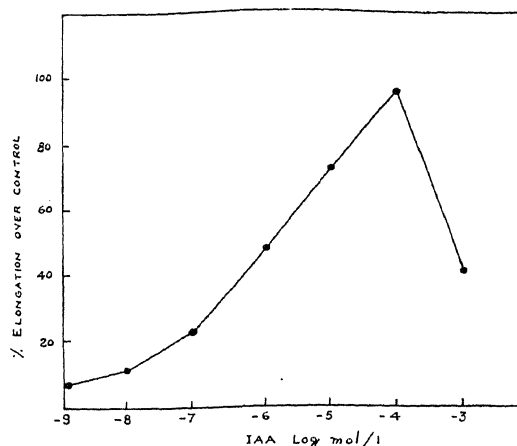


FIG. 1. Straight growth response of rice coleoptile segments to IAA. Each point represents an average length of 40 segments (4 experiments).

A linear response of rice coleoptile segments to IAA between 10^{-7} M and 10^{-4} M was observed. The total growth increment at 10^{-4} M was about 135% over original length of segments at the beginning of incubation. The control segments in sucrose solution showed only about 35% extension over their original length. Thus a net increment in growth of about 100% over control was observed at maximum.

The present results show that under the conditions tried, rice coleoptile response could well compare with that of oat coleoptile under optional conditions as reported by several workers.^{2,3,4} Hence it is believed that rice plant could be an useful addition to the plants already in use for the coleoptile straight growth test for auxin.

Department of Botany, V. S. R. DAS.
S.V. University, P. V. RAJU.
Tirupati (A.P.), August 25, 1965. M. P. RAO.

1. Bonner, J., *J. Gen. Physiol.*, 1933, **17**, 63.
2. Bentley, J. A., *J. Expt. Bot.*, 1950, **1**, 201.
3. Nitsch, J. P. and Nitsch, C., *Plant Physiol.*, 1956, **31**, 94.
4. Maheshwari, S. C. and Bhalla, P. R., *Indian J. Plant Physiol.*, 1964, **7**, 116.
5. Hancock, C. R., Barlow, H. W. B. and Lacey, H. J., *J. Expt. Bot.*, 1964, **15**, 166.

REVIEWS AND NOTICES OF BOOKS

Principles of Computation. By Dr. Peter Calingaert. (Addison Wesley Publishing Company, Inc., Reading, Massachusetts, U.S.A. and 10-15 Chitty St., London W. 1), 1965. Pp. viii + 200. Price \$ 7.50.

The volume under review, which requires only limited knowledge of elementary calculus, is intended for introductory courses dealing with computation, computers, or programming. Designed primarily for students of mathematics, engineering, the physical and natural sciences, and the quantitative social sciences, it presents a basic introduction to the principles of computation—both digital and analog, both automatic and manual. Although considerable stress is placed on the use of automatic computers, the primary focus remains on the fundamentals of computation. Thus, the textual development does not rely upon—nor does it discuss—any specific computer, either existing or hypothetical.

The text is divided into four major parts treating, in order, digital computation, numbers, analog computation, and numerical methods. In each case, various techniques and devices for solving computational problems are presented along with elements of the relevant mathematical theory. In addition, a collection of exercises is provided at the end of each part.

C. V. R.

Natural History of Aggression. Edited by J. D. Carthy and F. J. Ebling. (Academic Press, London and New York), 1964. Pp. vii + 159. Price 30 sh.

This volume presents the proceedings of a symposium on The Natural History of Aggression, arranged by the Institute of Biology, and held at the British Museum.

It ranges widely, dealing with aggressive behaviour in insects, birds and animals, with special attention devoted to man. While idealists may be appalled at some of the evidence of man's aggressiveness it is important that they—and everyone concerned with man's future—should take notice of the views of those who have made a study of the thread of aggression running through the behaviour of all animals.

This volume will appeal not only to those interested in animal behaviour, whether profes-

sional biologists or amateur naturalists, but also to psychologists and anthropologists.

C. V. R.

An Advanced Course in Practical Inorganic Chemistry. By D. N. Grindley. (Butterworth and Co., 88, Kingsway, London W.C. 2), 1964. Pp. xv + 184. Price 17 sh. 6 d.

In this book, the exercises have been devised with the following objects in view: Firstly, to teach the fundamental techniques which are common to many industries and which the student will meet in his professional life. Secondly, certain methods have been included to demonstrate some theoretical points, though the methods themselves may rarely be used in practice. Thirdly, certain exercises have been devised for the express purpose of making the student think and of leading to an interpretation of his results which will often require some degree of mental agility.

The subject-matter in this book has been dealt with under six sections whose titles are as follows: Section A: Exercises on Fundamental Techniques: Single Analysis; Part I—Gravimetric methods, Part II—Volumetric exercises and Part III—Reductor exercises; Section B: Preparations; Section C: Double Analyses and More Complex Methods; Section D: Investigation of Reactions; Section E: Complexometric Methods; Section F: Problems.

The book under review will be found useful by graduate students in Chemistry.

C. V. R.

Science and Human Values. By J. Bronowski. (Penguin), 1964. Pp. 94. Price 3 sh. 6d.

The three essays which make up this book were first given as lectures at the Massachusetts Institute of Technology on 26th February, 5th March, and 19th March 1963, when the author was Carnegie Professor there. In these essays he describes the essence of the creative process—that leap of the imagination which distinguishes the mathematician as much as the poet—and develops an ethic for science, which he describes as a human progress and no mere mechanism. Among the propositions the author puts forward are that the concept is more profound than its

laws and the act of judging more critical than the judgment.

The titles of the essays contained in this book are as follows: The Creative Misd; The Habit of Truth; The Sense of Human Dignity.

C. V. R.

Numerical Methods of Reactor Analysis, Volume 3 of *Nuclear Science and Technology: A Series of Monographs and Text-Books*. Edited by V. L. Parsegian Melville Clark and Kent F. Hansen. (Academic Press, New York and London), 1964. Pp. xi + 340. Price \$ 10.50.

The scope of this volume is indicated by the list of six chapter and four appendix headings given below: Chapter I. Linear Equations and Matrix Algebra; Chapter II. Difference Equations; Chapter III. Numerical Solutions of Equations; Chapter IV. Multigroup Diffusion Methods; Chapter V. Transport Methods; Chapter VI. The Monte Carlo Method; Appendix A. The Boltzmann Transport Equation; Appendix B. Velocity Relations for Nuclear Events; Appendix C. Moments Method for Neutrons; and Appendix D. Special Functions.

C. V. R.

Physics-Electronics Titles 1960—Bibliography and Key-Words Index of Titles of Leading Articles in About 200 Journals. (Boston Technical Publishers, Inc., 5 Bryant Road, Lexington, Massachusetts 02173, U.S.A.), 1964. Pp. vii + 455.

Physics-Electronics Titles Series is a new concept in the indexing of scientific and technical literature. The present volume covers titles which appeared in the year 1960.

The titles of the chapters contained in this volume are as follows: Journal Index; Key-Word-in-Context Index; Bibliography; Author Index; Non-Indexing Words.

The Author Index is an alphabetical listing of all authors of all the articles indexed. Printed along with each other is the reference code or codes of the articles authored. Thus articles by an author of interest can quickly be found in the Bibliography. The Journal Index is provided as a means of quickly ascertaining which publications were scanned. It is also a source for obtaining correct journal address for projected correspondence resulting from use of this volume.

C. V. R.

Quadratic Forms and Matrices (*Academic Paperbacks in Mathematics*—Edited by W. Magnus and A. Shenitzer). Author N. V. Yefimov. Translated and Edited by Shenitzer. (Academic Press, New York and London), 1964. Pp. ix + 163. Price \$ 2.45; Clothbound \$ 5.50.

An important distinction of this book is that it offers the reader insights which will enable him to appreciate more advanced presentations of the theory.

The chapter headings contained in this book are as follows: General Theory of Quadratic Curves; General Theory of Quadric Surfaces; Linear Transformations and Matrices.

Appendix I is a summary (by the translator) of relevant material on vectors and operations on vectors.

Appendix II is an abbreviated version of a supplement to Prof. Yefimov's "Short Course in Analytic Geometry" and treats elements of the theory of determinants and of systems of linear equations.

C. V. R.

A Photographic Atlas of Shark Anatomy. By Carl Gans and Thomas S. Parsons. (Academic Press, New York and London), 1964. Pp. 106.

The spiny dogfish, *Squalus acanthias* Linne, is one of the most widely used animals in comparative anatomy laboratories. The present Atlas of photographs provides a detailed visual guide to the morphology of this common form.

The Atlas is not intended as a substitute for a dissection guide, but as a supplement to a course of dissection. Therefore, the text, confined to a few explanatory comments opposite each page, has been reduced to a minimum. Its purpose is to call attention to points which, though illustrated, are often missed by students. Mention is also made of special problems in anatomical terminology. Embryological and histological material has, however, been omitted. Not all specimens are exactly alike. Sexual dimorphism affects overall size and shape of the body and the pelvic fins, as well as the gonads and other parts of the genital system. In addition there are frequent variations in other structures, especially in the circulatory system. Thus, although major anomalies have been avoided in the photographs, the latter cannot be expected to correspond perfectly to any particular specimen in the laboratory.

Students of zoology, laboratory instructors and others who may desire a guide to the

morphology of the species cited above will find this book to be of great value.

C. V. R.

Bird Structure. By D. A. Ede. (Hutchinson Educational Limited, 178-202 Gt. Portland St., London W. 1), 1964. Pp. 120. Price 15 sh.

The fowl has been used as the basis of all descriptions in this book, but the structure of birds is remarkably uniform, and another species such as the pigeon may be used without difficulty, provided that an eye is kept open for the minor differences that do exist. Directions for dissection are distributed throughout the book, usually after description of each organ system and an account of its development. The drawings given are meant to supplement and clarify the text.

The titles of the chapters contained in this book are as follows: Introductory; The Covering of the Body; The Skeleto-Muscular System; The Viscera; The Head, The Respiratory System and the Nervous System.

This book will be found useful by anyone who wishes to acquire an elementary knowledge of bird structure, whether he be a high-school student, a university student or a more advanced student from some other discipline—a physiologist, a veterinarian or a poultry scientist—turning to the bird in connection with some particular problem.

C. V. R.

Advances in Marine Biology (Vol. 2). Edited by F. S. Russell. (Academic Press, London and New York), 1964. Pp. x + 274. Price 57 sh. 6d.

The aim of this new serial publication is to help biologists to keep abreast of knowledge in the different lines of research on the biology of marine organisms.

The present volume under review contains the following four important contributions: 1. The Artificial Propagation of Marine Fish, by J. E. Shelbourne; 2. The Blood Groups of Marine Animals, by John E. Cushing; 3. The Present Status of Some Aspects of Marine Microbiology, by Robina B. Scholes and J. M. Shewan; and 4. Methods of Sampling the Benthos, by N. A. Holme.

C. V. R.

Categories of Human Learning. Edited by Arthur Melton. (Academic Press, New York and London), 1964. Pp. xvi + 356. Price \$ 8.50.

This volume presents a study of the most promising topics for the advancement of our

understanding of human learning and the inter-relationships of types of learning. The participants of this symposium placed particular emphasis on: a full-scale consideration of the varieties of learning properly described as "conditioning", second-order habits (concepts, rules, sets) in all forms of human learning—their development (and loss) and utilization, and mediating processes.

C. V. R.

Structure and Metabolism of Corticosteroids.

Edited by J. R. Pasqualini and Max F. Jayle. (Academic Press, New York and London), 1964. Pp. x + 168. Price 35 sh.

This co-operative volume describes the chemical structure of corticosteroids and their metabolic transformations, both *in vitro* and *in vivo*, under normal and physio-pathological conditions.

The main topics dealt with are: The Importance of the Magnetic Resonance Spectra in the Study of Steroid Structure; The Relation between the Structure of Corticosteroids and their Form of Conjugation in the Human Organism and Some Pathological Aspects of Corticosteroid Metabolism.

This book will be of great interest to research workers and advanced students in the field of biochemistry, physiology, pathology and medicine.

C. V. R.

Advances in Experimental Social Psychology (Vol. 1). Edited by Leonard Berkowitz. (Academic Press, New York and London), 1964. Pp. xi + 319. Price \$ 9.00.

The present volume contains the following eight contributions by the authors whose names are shown against each: Cultural Influences upon Cognitive Processes, by Harry C. Triandis; The Interaction of Cognitive and Physiological Determinants of Emotional State, by Stanley Schachter; Experimental Studies of Coalition Formation, by William A. Gamson; Communication Networks, by Marvin E. Shaw; A Contingency Model of Leadership Effectiveness, by Fred E. Fiedler; Inducing Resistance to Persuasion, by William J. McGuire; Social Motivation, Dependency, and Susceptibility to Social Influence, by Richard H. Walters and Ross D. Parke; and Sociability and Social Organization in Monkeys and Apes, by William A. Mason.

C. V. R.

Dover Publications :

1. **Electronic Processes in Ionic Crystals.** By N. F. Mott and R. F. Gurney, 1964. Pp. xii + 275. Price \$2.00.

This is an unabridged, unaltered republication of the second edition of 1948. The subject-matter in this edition is dealt with in eight chapters as follows: I. The Perfect Ionic Lattice; II. Lattice Defects in Thermal Equilibrium; III. Electrons in Ionic Crystals; IV. Colour Centres in Alkali-Halides and Allied Phenomena; V. Semi-Conductors and Insulators; VI. Luminescence and the Dissipation of Energy; VII. Photochemical Processes in Silver Halides and the Photographic Latent Image; and VIII. Processes Involving the Transport of both Ions and Electrons.

Though a great deal has taken place in the field in recent years, this book continues to serve as a valuable text and reference book for students and workers in solid-state physics, chemistry, crystallography, and related fields.

2. **Structure of Molecules and the Chemical Bond.** By Y. K. Syrkin and M. E. Dyatkina, 1964. Pp. ix + 509. Price \$2.75.

This book is an unabridged and unaltered republication of the English translation of the 1950 edition. It presents a coherent, comprehensive account of structural chemistry—a complex, but important area of modern chemistry. The authors have furnished a well-balanced wave mechanical treatment of the field. They have also endeavoured to link theoretical aspects with practical measurements so that the reader can properly grasp recent developments and problems. An interesting feature of the book is that it brings together in one volume a large amount of theoretical material and experimental data otherwise to be found only scattered in books and periodicals. Practising chemists and students will find this an exceptionally useful addition to their working libraries.

3. **The Solubility of Non-electrolytes.** By Joel H. Hildebrand and Robert L. Scott, 1964. Pp. xiv + 488. Price \$2.50.

The present edition is an unabridged and corrected republication of the third edition of the work published in 1950, with new material. This is one of the great pioneering works in the systematic study of the theory of solubility and of practical problems involving intermole-

cular forces. This work will be found useful by all teachers, workers and advanced students of chemistry and chemical engineering as a comprehensive reference and study text.

- Nucleic Acids: Proceedings of a Symposium** (Published by Publications and Information Directorate, Council of Scientific and Industrial Research, Hillside Road, New Delhi-110 055). Pp. 361. Price Rs. 20; 40 sh. 6 p.

As essential materials of heredity and carriers of genetic information that specify the structure of organisms as also their diversity, nucleic acid substances of systematic and evolutionary interest have evoked phenomenal interest in modern research. Literature on the subject is growing so rapidly that it has become essential to hold frequent symposia and conferences on the subject to exchange views and ideas. The present publication is the outcome of such a symposium organized at the Biological Research Laboratory, Hyderabad, from January 16-22, 1964 under the auspices of the C.S.I.R. The symposium was attended by invited participants from many countries and by a large number of observers representing scientific research centres in India.

The volume contains 31 articles contributed by 77 scientists and they cover various aspects of study of nucleic acids, their synthesis, biosynthesis, function, etc. This collection of nucleic acids literature will be welcome to the workers in the field.

Books Received

- An Atlas of Models of Crystal Structures*. By J. F. Nicholas. (Gordon & Breach Science Publishers, New York-11), 1965. Pp. xv + 279. Price \$27.50.
- A Handbook of Systematic Botany*. By J. D. Datta. (Asia Publishing House, Cantonment Road, Ballard Estate, Bombay-11), 1965. Pp. xiv + 435. Price Rs. 18-00.
- Concise Notes in Inorganic Chemistry*. By R. Lowrie. (Pergamon Press, London), 1965. Pp. vii + 150. Price 12 sh. 6 d.
- Advances in Theoretical Physics* (Vol. 1). Edited by K. A. Brueckner. (Academic Press, New York), 1965. Pp. x + 323. Price \$12.00.
- The Control of Fertility*. By G. Pincus. (Academic Press, New York-10003), 1965. Pp. xvii + 360. Price \$9.00.

THE NEW PHYSIOLOGY OF VISION

Chapter XXXIV. The Nature and Origin of Defects in Colour Vision

SIR C. V. RAMAN

THE studies described in the two preceding chapters provided an insight into the problem of explaining why certain individuals differ in their perceptions of colour from most other persons. At the same time, it became evident to the author that the new methods of study introduced by him in this field should be applied to more cases of the kind and carried out more exhaustively than was found possible in the examples first described. The present communication sets out the results of such a fuller study carried out in particularly favourable circumstances. It owes much to the co-operative spirit and scientific competence of the person whose colour vision is here described and discussed in detail. He will be named here as Asoka which of course is not his real name. Asoka is a physicist of several years' standing with academic experience and had long been aware that his colour perceptions are not of the normal kind. This fact came to his notice when he found that the $\lambda 5461$ radiation of a mercury lamp appeared to him to exhibit the same colour as the $\lambda 5770$ - 5790 doublet, whereas the first is usually described as green and the second as yellow.

The spectrum of white light from a brilliant source was focused on a ground-glass screen at the observing end of a glass spectrograph successively at three different levels of illumination, and Asoka was asked to indicate and describe what he saw in each case. Seen at the highest level of brightness, the spectrum appeared to him to begin at the long-wave end at about the same place as for a normal individual. But it commenced with an orange region and this was followed by bright yellow and then successively by a light blue, a dark blue and then violet. The change from yellow to blue appeared in the region when normal observers notice the change from green to blue. The short-wave end of the spectrum also agreed in position with those of normal observers. Asoka, when asked to locate the part of the spectrum which appeared to him to be the most luminous, put his pointer on the spot which appears yellow to normal individuals. At a lower level of intensity, the spectrum appeared to have become shorter at both ends, but the yellow part remained unaffected. At the lowest

level of intensity which was attained by introducing a sheet of opal glass between the source of the light and the spectrograph, only the part which appeared yellow in the first case could be seen, but it did not exhibit colour except at the long-wave end where it showed a weak orange tint.

Asoka was asked to hold a diffraction grating before his eye and to view through it, a slit between the two nearly-closed wooden shutters through which the light from the brilliantly illuminated sunlit sky found entry into the room. In the highly luminous first-order diffraction spectrum seen in these circumstances, Asoka reported seeing the colour sequence of red, orange, yellow, blue, indigo and violet. He could also see the Fraunhofer lines in the spectrum, as both the dispersion and resolution were adequate.

Asoka's colour perceptions were then tested by presenting to him in succession four different examples of interference patterns exhibiting colour and asking him to write down a detailed description of what he saw in them. The following is his description of a pattern of circular rings of the well-known Newtonian type. "The centre of the system is dark. This is surrounded by circular rings. The first ring is colourless. This is followed by (1) an orange, (2) deep blue, (3) orange, (4) light blue, (5) yellow, (6) light blue, and (7) light yellow. Beyond these rings, four alternate dark and colourless rings are also observed." Another pattern of the same type but on a slightly smaller scale was described by him as follows: "The centre of the pattern is dark. This is followed by coloured circular rings in the following order: (1) colourless, (2) deep orange, (3) deep blue, (4) orange, (5) light blue, and (6) light yellow. This is followed by three alternate dark and bright (colourless) rings."

The interference colours exhibited by a wedge-shaped air-film between two flat plates of glass was described by Asoka as follows: "The pattern consists of several bands more or less of uniform width. The band at the edge where the thickness of the wedge is minimum is dark. This is followed by (1) colourless, (2) red, (3) deep blue, (4) deep orange, (5) blue, (6) light orange, (7) light blue, and

(8) very light yellow bands. This is followed by five alternate dark and bright (colourless) bands."

The fourth interference pattern was of a special type obtained by using two rectangular glass plates clamped together at the edges. This was viewed normally by reflected skylight incident on the plates in the direction of observation. Asoka described what he saw as follows: "The pattern consists of a central region which is light yellow surrounded by several ovals. Three of the ovals are alternately bright (no colour) and dark. The fourth one is orange followed by (5) blue, (6) orange, (7) deep blue, (8) deep orange, (9) deep blue, and (10) red ovals."

Commentary on the Foregoing.—Before reporting on further observations of other kinds by Asoka, we may usefully pause here to consider the significance of his descriptions of the interference patterns quoted above *in extenso*. They are remarkable in several respects. Firstly, they are totally different from the descriptions which would be given by a normal observer. Secondly, they report the appearance of alternations of intensity without any manifestations of colour precisely in those regions of the pattern where a normal observer would report alternations of colour without alternations of intensity. Thirdly, they report alternations of colour in the regions where to a normal observer the major features which present themselves are the alternations of intensity. These features are a highly characteristic expression of the differences between normal and Daltonian colour vision.

The basis for an understanding of Daltonian colour vision is furnished by the fact emerging from studies with normal observers that the yellow of the spectrum exhibiting its maximum of luminosity at $579\text{ m}\mu$ plays the major role in their colour perception, while the red and green observed on either side of the yellow in the spectrum are only subsidiaries or accompaniments of it. If, therefore, the red and the green sensations were left out, we would be left with the yellow and the blue sectors of the spectrum. This fits with Dalton's description of the colours in the spectrum as perceived by himself.

In the colours exhibited by interference patterns as seen by a normal observer, the fringes of higher order show bands of colour which may be described as alternations of red and green respectively. If these colours are not perceived, the same regions would exhibit the effects arising from the yellow and the blue

sectors of the spectrum. The yellow being much the more intense may be expected to produce alternations of intensity in these regions. But the superposition of the effect of the blue sector would result in these alternations of brightness appearing more or less perfectly achromatic. This agrees with the observations of Asoka in all the four cases examined by him. In the interferences of lower orders, the alternations of intensity due to the yellow sector would be superposed on those due to the blue sector. These would not coincide with one another. Hence, in these regions, alternations of colour would be observed, the colours becoming progressively less saturated as we proceed from the lower to the higher orders of interference. This also agrees with the observations of Asoka.

A feature of special interest is the appearance of orange in Asoka's descriptions both of the colours of the spectrum as also of the interference patterns. That orange and yellow were perceived by him as distinct colours is clear from his recognition of these colours in various flowers shown to him. In particular, when shown the cluster of flowers of *Bignonia venusta* which he had not seen previously, he named their colour as orange without any hesitation. Since orange follows red in the succession of colours in the spectrum, this is an indication that the sensation of red was not completely absent in his perceptions of colour. It is noteworthy that in his description of the solar spectrum as observed at a high level of intensity, red does find a place. It also finds a place in his description of the fringes of lowest order in two of the interference patterns shown to him.

But on the other hand, there is evidence that his perception of red is much weaker than that of normal individuals. This is clear from his inability to read the test-chart No. 10 in the set published by the American Optical Company (1940), which had evidently been designed to reveal such a weakness. In this test-chart, the numeral 9 is figured very conspicuously as a sequence of curiously shaped spots of a dull red hue, surrounded by spots of similar shape and printed in grey and black. The contrast of colours is very striking, but Asoka could not perceive it. A further indication of the weakness of his perception of red is the noticeable shortening of the spectrum at the long-wave end when its brightness is diminished.

Other Observations.—It may be worth listing here Asoka's readings of the test-charts commonly employed to reveal defective colour vision. Both the Ishihara charts and those published by the American Optical Company

exhibit as the first of the series, the numeral 12 in orange surrounded by a field of spots of a bluish colour. This is read without difficulty or hesitation alike by normal persons and by those with defective colour vision. Charts 2 to 9 in the Ishihara set are designed so that persons with normal and defective colour vision would read the numbers differently. Asoka responded to every one of them in the manner expected of one with defective colour perception. He was unable to decipher the numbers appearing in chart Nos. 10 to 17 and also in charts Nos. 22 to 24 of the set of the Ishihara series.

Asoka was also presented with the test-charts published by the American Optical Company. This contained a set of 19 sheets. He did not succeed in reading the numerals appearing in charts 2, 3, 6, 7, 8, 9, 10, 11, 14, 15, 16 and 17. But he read correctly and without hesitation the numerals appearing in charts 4, 5, 12, 13, 18 and 19. It may be noted that these latter charts exhibit numerals printed in pale yellows and reds and surrounded by a field of dots of varying depths of green, or *vice versa*. That he could do so indicates that his perceptions of red and green differed noticeably from each other.

Asoka was taken round the gardens of the Institute and asked to name the colours of various flowers shown to him. All yellow flowers were recognised by him as such without any hesitation; likewise, flowers with orange hues, *viz.*, marigold and *Bignonian venusta*. The scarlet flowers of *Cordia sebestina* were described by him as red tending to orange.

Various red and crimson flowers were named by him without hesitation as red and deep red respectively.

The deep blue flowers of the Morning Glory were named by him after some hesitation as violet in colour. The purplish-red flowers of the ground Orchid *Spathoglottis plicata* were also described by him as violet in colour. The flowers of the blue iris, and the pale blue flowers of *Plumbago capensis* were with some hesitation named by him as light blue.

His description of the colours of the bracts of different varieties of *Bougainvillea* differed markedly from that of a normal observer. The light purple and the deep purple varieties were alike described by him as blue, while the rose-red bracts of another well-known variety were described by him as purple.

His naming of the colours of different varieties of pelargonium were not widely different from those of normal observers. Remarkably enough, Asoka said he had no difficulty in recognising the green colour of leaves as such, provided they were deep enough, and not the paler hues often manifested.

Concluding Remarks.—Summing up, the colour perceptions of Asoka may be described as being approximately Daltonian in character but not absolutely typical, since his reds and greens were not wholly indistinguishable from each other. There are indications that Asoka's perceptions of red are much weaker and his perceptions of yellow much stronger than those of normal individuals.

CHEMICAL OCEANOGRAPHY *

THIS treatise is intended primarily for advanced students and research workers in chemical oceanography, and it gives a comprehensive, authoritative and up-to-date account of the subject. It thus embraces not only sea-water chemistry as such, but also gives consideration to the interaction of sea-water with marine sediments and to the chemical factors controlling marine productivity. Each chapter has been contributed by a specialist author and the work has been so designed to be useful to workers in related fields such as marine biology and geology.

The present volume under review deals with sea-water, its chemistry, and the processes controlling its composition, and with the interaction between marine organisms and the nutrient elements and compounds. The titles of the chapters contained in this volume are listed as follows: Historical Introduction; Currents and Mixing in the Ocean; The Physical Properties of Sea-Water; The Major Constituents of Sea-Water; Minor Elements in Sea-Water; Dissolved Gases other than Carbon Dioxide; The Dissolved Gases—Carbon Dioxide; Phosphorus; Inorganic Nitrogen in Sea-Water; Silicon; The Dissolved Organic Constituents of Sea-Water; Production of Organic Matter in the Primary Stages of the Marine Food Chain; Anoxic Basins and Fjords.

* *Chemical Oceanography*, Volume 1. Edited by J. P. Riley and G. Skirrow. (Academic Press, London and New York), 1965. Pp. xix+712 Price 147 sh.

THE DEGRADATION OF AROMATIC COMPOUNDS BY *ARTHROBACTER* SPECIES

M. F. MULLAKHANBHAI AND J. V. BHAT

Fermentation Technology Laboratory, Indian Institute of Science, Bangalore-12

THE generic name *Arthrobacter* is given to a group of bacteria which are aerobic and pleomorphic. When young, the cells of this group appear as rods of irregular form and variable length. Both V-shaped cells and curved rods frequently occur in young cultures grown in complex media; occasionally filaments and branching forms are also seen. Upon aging, however, the rod-shaped cells turn into coccoid forms.¹ The observation that the *Arthrobacter* species occur widely in soil, water, sewage, activated sludge, plant residues and cheese,² clearly point to their role in nature though much remains to be revealed about their activities. It would appear that *Arthrobacter* are of great importance in the degradation of plant residues in soils and a few species have been shown to decompose fats (tributyrin, tripalmitin) and oils (coconut and wheat germ) besides proteins. In general they are inert towards carbohydrates in the sense they produce little or no acidity from sugars in peptone water medium, though they may attack glycerol³ and inositol⁴ to form acids. A few strains have recently been encountered in the decomposing pectic substances.⁵ The object of the present communication is to report on the capabilities of *Arthrobacter* species to attack aromatic compounds.

To date the study of the degradation of aromatic compounds by micro-organisms was restricted to a few genera of bacteria such as *Pseudomonas*, *Achromobacter*, *Vibrio*, *Mycobacterium*, *Nocardia* and *Micrococcus*. Enrichments set with aromatic compounds like phenol, benzoic acid, hippuric acid,⁶ etc., have generally been reported to result in the isolation of *Pseudomonas*, *Vibrio* and *Achromobacter* and so far as the authors are aware, there is no record of isolation of *Arthrobacter* group of organism possessing the ability to degrade aromatic compounds. From the findings made in this laboratory, it would appear that *Arthrobacter* species have a vital part to play in the turnover of nature's carbon resources in general and mineralization of aromatic compounds in particular.

Out of a collection of 170 strains isolated in this laboratory, 16 strains of *Arthrobacter* were selected for a detailed study with respect to their ability to utilize aromatic compounds.

Seven of the strains selected belong to a group of yellow-pigmented ureolytic species (a detailed report on them is *in press*), while seven others are of the red-pigmented variety. One strain, tentatively identified as *A. tumescens*, along with another strain, which appeared to be non-pigmented variant thereof were also included in this investigation. All the 16 strains were examined for their ability to attack 41 aromatic compounds chosen for this work. The large number of compounds upon which they were found to grow revealed their vast potentialities in the conversion of aromatic into aliphatic compounds. The red-pigmented *Arthrobacter* species could in fact grow very well in a basal mineral medium⁷ containing 0.001% yeast extract and such compounds as hippuric acid, benzoic acid, *m*-hydroxybenzoic acid, *p*-hydroxybenzoic acid, phenylacetic acid, protocatechuic acid, gentisic acid, phenol, benzaldehyde, benzylalcohol, catechol, *p*-cresol and tyrosine. Other compounds like benzene, phloroglucinol, orcinol, resorcinol, *m*-cresol, *p*-aminobenzoic acid, *m*-aminobenzoic acid, *o*-aminobenzoic acid and gallic acid also supported their growth to some extent. Surprisingly, *o*-hydroxybenzoic acid could not support growth. All others, *viz.*, pyrogallol, *p*-nitrophenol, *m*-nitrophenol, 2:4-dinitrophenol, *o*- and *p*-aminophenol, *o*- and *m*-toluidine, quinol, hydroquinone, hydroxyhydroquinone, indole, tryptophan, phenylalanine, phthalic acid, 1:3-dihydroxynaphthalene, 2:7-dihydroxynaphthalene and β -naphthol, also failed to support growth. The yellow-pigmented ureolytic *Arthrobacter* species differed from the previous group only in a minor respect, *viz.*, in their ability to attack catechol and gentisic acid.

A. tumescens strains were even more interesting in the sense that they grew very well on *p*- and *m*-hydroxybenzoic acid and *o*-aminobenzoic acid and to a lesser extent on *m*- and *p*-aminobenzoic acids but not on *o*-hydroxybenzoic acid. Benzylalcohol, benzaldehyde and *p*-cresol, which supported good growth of the other 14 strains, also failed to support their growth though phenylacetic acid served exceedingly well as a growth substrate.

From the above results it would appear that in general the *Arthrobacter* species are unable to use, under the conditions of test, diphenyl

compounds and the phenolic compounds substituted with $-\text{NO}_2$ and $-\text{NH}_2$ groups. The presence of single hydroxyl group or an aliphatic side-chain appeared to aid in rendering the ring compound suitable for good growth. Also, the position of the $-\text{OH}$ group in benzoic acid molecule seemed to be the factor determining the capability of the organism to attack it. For example, *m*- and *p*-hydroxybenzoic acids, but not the *ortho* counterpart, are very well utilized by *Arthrobacter* species. Similarly, whereas *p*-cresol supported very good growth, *m*-cresol does so only to a limited extent. The presence of a carboxyl group in the benzene ring, it would seem, can make it a better growth substrate. Thus the growth rate is higher on benzoic acid, *p*- and *m*-hydroxybenzoic and phenylacetic acids than on benzene or phenol. However, in the case of carboxylic acid derivative, *o*-hydroxybenzoic acid and phthalic acid could not support growth. Quinones, in general, are not utilized presumably because of their toxic effect. Catechol, which supported good growth of the red-pigmented *Arthrobacter* species, failed to support the growth of the yellow variety notwithstanding the fact that catechol is known to be the key intermediate in the metabolism of most of these compounds.

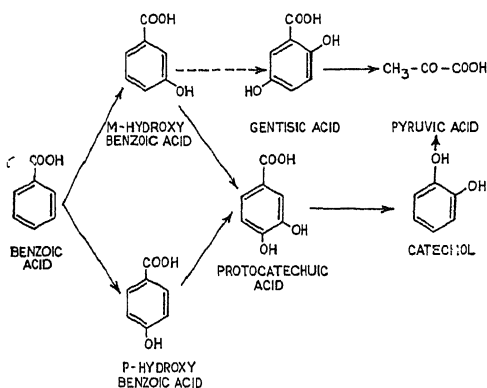


FIG. 1. Metabolic pathway of benzoic acid by *Arthrobacter* species.

From the results recorded of manometric experiments⁸ and on the basis of simultaneous adaptation theory⁹ the pathways of metabolism of benzoic acid in *Arthrobacter* would seem to proceed on the lines indicated in Fig. 1. These pathways are different from those reported earlier,^{6,10} e.g., in *Pseudomonas convexa* var. *hippuricum* which forms catechol from benzoic acid *via* salicylic acid and catechol, in its turn, is converted into *cis-cis* muconic acid. *Vibrio* 0/1, on the other hand, first converts benzoic

acid either to *p*-hydroxybenzoic acid or *m*-hydroxybenzoic acid before protocatechuic acid is formed. It seems catechol is not involved in the pathway. In *Rhodopseudomonas* sp.¹¹ a different pathway in which the benzoic acid is directly metabolised *via* protocatechuic acid and catechol without involving the monohydroxy derivatives of benzoic acid has been postulated. At any rate, in the red-pigmented *Arthrobacter* species investigated by us an altogether new pathway of metabolism of benzoic acid seems to operate in that the substrate not only gets metabolised *via* protocatechuic acid and catechol but also *via* gentisic acid as indicated by the broken lines in Fig. 1. In fact these species most effectively bring about the formation of catechol from hippuric or benzoic acids or any other intermediates involved in the system. It is also noteworthy that pyruvic acid, and not *cis-cis* muconic acid and so on, is the breakdown product of catechol in the metabolism of these compounds by the *Arthrobacter* species studied.

An interesting observation made in this connection is that the yellow-pigmented species when grown on hippuric acid, benzoic acid, or *m*-hydroxybenzoic acid under low oxygen tension, consistently elaborate a dark brown soluble pigment which gives a positive catechol test. The cells also reveal the presence of dehydrogenase enzyme system capable of dehydrogenating catechol. This observation is suggestive of the formation by cells of *o*-benzoquinone from catechol, a compound which can give rise to hydroxyhydroquinone possessing the property to polymerize itself into highly coloured complexes.¹²

1. Conn, H. J. and Dimmick, I., *J. Bacteriol.*, 1947, **54**, 291.
2. Mulder, E. G. and Antheunisse, J., *Ann. Inst. Pasteur.*, 1963, **105**, 46.
3. Shethna, Y. I. and Bhat, J. V., *Antonie van Leeuwenhoek*, 1962, **28**, 289.
4. Paranjape, V. N. and Bhat, J. V., *Proc. Natl. Inst. Sci. (India)*, 1962, **28**, 532.
5. Jayasankar, N. P. and Bhat, J. V. (Unpublished results).
6. Bhat, M. G., Ramakrishnan, T. and Bhat, J. V., *Can. J. Microbiol.*, 1959, **5**, 109.
7. Khambata, S. R., Iyer, V., Iyer, R. V., Bhat, M. G. and Bhat, J. V., *Indian J. Agric. Sci.*, 1960, **30**, 91.
8. Umbreit, W. W., Burris, R. H. and Stauffer, J. F., *Manometric Techniques*, Burgess Pub. Co., N.Y., 1957.
9. Stanier, R. Y., *J. Bacteriol.*, 1947, **54**, 339.
10. Evans, W. C., *Biochem. J.*, 1947, **41**, 373.
11. Proctor, M. H. and Scher, S., *Ibid.*, 1960, **76**, 33.
12. Nelson, J. M. and Dawson, C. R., *Advances in Enzymology*, 1944, **4**, 99.

SYMPTOMS AND DIAGNOSIS OF THE BACTERIAL BLIGHT DISEASE OF RICE.

D. N. SRIVASTAVA AND Y. P. RAO

Division of Mycology and Plant Pathology, Indian Agricultural Research Institute, New Delhi

THE 1963 epidemic of a leaf-drying disease of rice in Shahabad, Bihar and several other States led to considerable confusion with regard to its cause until the authors (1963, 1964 a) conclusively demonstrated the bacterial nature of the disease, commonly called bacterial blight, incited by *Xanthomonas oryzae* (Uyeda and Ishiyama) Dowson. This disease is widely prevalent in the eastern countries, viz., Japan, China, Formosa, Philippines, Thailand, Indonesia, Malaya and has been recently reported from Ceylon also.

The only Indian record of occurrence of the disease, based on isolation and pathogenicity of the bacterium, prior to the epidemic of Bihar, was from Bombay by Sreenivasan *et al.* (1959). While the symptoms described by them are suggestive of the non-vascular streak disease of which the pathogen is *X. oryzicola* Fang *et al.*, the bacterium isolated and worked with appears to have been *X. oryzae* by virtue of its requirement of enriched medium for growth as also its ability to infect the vascular system of the host. Goto (1964) considers *X. oryzicola* Fang *et al.* to be *X. translucens* f. sp. *oryzae* Pordesimo. Based on a careful study of the properties and pathogenicity of a large number of isolates of both bacteria, Goto differentiates the blight and streak pathogens into two distinct species.

Since the disease has assumed national importance and has attracted the attention of a large number of workers, the present paper is aimed to provide a clear picture of the symptoms and methods of field diagnosis of the disease.

During August 1964 the bacterial blight disease was reproduced in a 10 weeks old rice crop of T. 90 by spraying pure cultures of a virulent strain of *X. oryzae*, originally isolated from diseased leaves of the previous year's epidemic in Bihar. The seeds were treated by the method published earlier by the authors (1964 b). A sub-culture of the bacterium has been deposited in the International Collection of Phytopathogenic Bacteria, maintained by Dr. M. P. Starr, Professor of Bacteriology, University of California, Davis, California.

The symptoms of the disease become visible one week after inoculation and are characterised

by linear straw coloured stripes, rarely on one and generally on both margins of the leaves, starting from the tip downward (Fig. 1). This is



FIGS. 1-2. Fig. 1. Infected rice leaves showing various patterns and stages of blighting. Fig. 2. A piece of infected leaf showing bacterial ooze, $\times 970$.

followed by drying of the leaf dip, inward rolling and twisting (somewhat spiral) of the

infected portion of the leaf. The marginal blight extends rapidly to cover larger area of the leaf crosswise and lengthwise, usually leaving small green areas in the centre, which in course of time also get blighted. In occasional cases, the linear stripes develop on the leaf lamina or along the midrib with or without the marginal stripes. These are yellowish in the beginning but become straw coloured later. After blighting, the leaves unroll and support growth of sooty moulds. The disease extends to the leaf-sheaths and culms, killing the tiller or the whole clump. The glumes of the seeds are also infected, but the symptoms are not well defined. The disease remains aggressive throughout the monsoon season at the end of which some new tillers are produced which are either mildly infected or remain green.

Inoculations made on 3-4 weeks or older seedlings also produce the above symptoms, but seedlings younger than 2 weeks show bleaching of the leaf tips followed by rapid wilting.

When a small piece of the blighted leaf-sheath or culm is mounted in water and examined under the microscope, cloudy masses of the bacterium are seen oozing out from the vascular strands (Fig. 2). The ooze is profuse during active development of the disease. Blighted leaves stored at room temperature retain the ability to show the bacterial ooze even after 12 months. Pure cultures of the bacterium can be established by streaking dilutions of the ooze on nutrient agar. This is easier from fresh lesions than from advanced stages of blighting. In the latter, several saprophytic bacteria occur, some of which can be readily mistaken for *X. oryzae* on account of their yellow colour. The inoculum prepared from freshly infected leaves by suspending finely chopped pieces in a beaker of water is as infective as the pure culture. Thus, where facilities do not exist for isolation and purification of the bacterium, the inoculum prepared in this manner can be used for experimental purposes.

When a piece of the infected leaf was placed in a few drops of water on a clean glass plate, the water became turbid on account of the bacterial ooze within 10-15 minutes. When a six-inch piece of an infected leaf was half immersed in water in a glass tumbler, very tiny droplets of the bacterial ooze appeared on the

immersed edge of the leaf and gradually dispersed in the water. A piece of the infected culm suspended in the same manner released larger masses of the bacterium. These tests can be readily employed even by a layman for field diagnosis of the disease. Leaves killed or dried due to reasons other than bacterial infection do not respond to these tests.

Between August and October, 1964, the authors undertook a survey of some of the intensive rice-growing areas in U.P., Bihar, West Bengal, Orissa, Andhra Pradesh and Maharashtra. The disease was found to be prevalent in varying degrees of intensity in all the States, the foci of epidemic being Basti, Gorakhpur and Banaras in U.P., Shahabad in Bihar, Chinsurah in West Bengal, Sambalpur in Orissa, Rajendera Nagar in Andhra Pradesh and Karjat and Khopoli in Maharashtra. The symptoms of the disease was identical with those produced in the artificially inoculated crop at Delhi. Bits of infected leaves collected from these places showed the characteristic bacterial ooze from the vascular strands from which pure cultures of *X. oryzae* were established in all cases.

Some of the local names given by farmers to leaf-drying diseases of paddy are *Pansukh* in most parts of North India, *Dakhina* in Bihar and *Khaira* in the Terai regions of U.P. The identity of the diseases under these names is somewhat obscure. The authors wish to caution the investigators against interpreting all these as bacterial. While the bacterial blight essentially involves leaf-drying, its distinction from other causes of leaf drying is quite easy with the symptoms and the diagnostic tests described in this paper.

The authors acknowledge their grateful thanks to Dr. B. P. Pal, Director-General, Indian Council of Agricultural Research and Dr. A. B. Joshi, Director, Indian Agricultural Research Institute, for their keen interest in this work. Thanks are also due to Dr. S. P. Raychaudhuri, Head of the Division of Mycology and Plant Pathology, for his suggestions in writing up the manuscript.

1. Goto, M., *Report of the Faculty of Agriculture*, Schizuke University, Japan, 1964, 14, 3.
2. Sreenivasan, M. C., Thirumalachar, M. J. and Patel, M. K., *Curr. Sci.*, 1959, 28, 469.
3. Srivastava, D. N. and Rao, Y. P., *Indian Phytopath.*, 1963, 16, 393.
4. — and —, *Ibid.*, 1964a, 17, 77.
5. — and —, *Indian Farming*, 1964b, 14 (6), 32.

LETTERS TO THE EDITOR

ULTRA-VIOLET ABSORPTION
SPECTRUM OF PARA-ETHYL
PHENOL VAPOUR

THE near ultra-violet absorption spectrum of para-ethyl phenol has been photographed for the first time in the vapour phase on a medium quartz spectrograph using absorption path lengths varying from 25 to 150 cm. The temperature of the absorption cell was varied from -10°C . to 150°C . The sample of para-ethyl phenol was distilled in vacuum before use.

About 30 red-degraded bands lying in the region $\lambda 2540$ to $\lambda 2890$ have been observed. Most of the bands are rather broad with fairly sharp heads. The intense band at 35478 cm^{-1} has been chosen as the (0,0) band.

The rather strong bands on the shorter wavelength of the (0,0) band with frequency differences 405, 576, 812, 1048 and 1229 cm^{-1} have been assigned as the excited state fundamentals and the bands at intervals 459, 637 and 848 cm^{-1} on the longer wavelength side of the (0,0) band have been assigned as ground state fundamentals. These three ground state and five excited state fundamentals can account for almost all the observed bands. The symmetry of the molecule is represented approximately by the point group C_{2v} and the observed bands are ascribed to the electronic transition $\text{A}_1\text{-B}_1$, allowed for this molecule.

The infra-red absorption spectrum of this molecule has been recorded in the nujol mull on a Perkin-Elmer Model 221 double-beam automatic spectrometer with sodium chloride prism-grating interchange, as the data in the literature¹ are not available. The ground state fundamental 848 cm^{-1} corresponds to the observed infra-red frequency 830 cm^{-1} and the upper state frequencies 1048 cm^{-1} and 1229 cm^{-1} correlate respectively with the observed infra-red frequencies 1125 cm^{-1} and 1260 cm^{-1} .

Similar work on some other ethyl phenols is in progress.

Dept. of Physics, M. A. SHASHIDHAR.
Karnatak University, K. SURYANARAYANA RAO.
Dharwar-3, December 11, 1965.

1. Salimov, M. A., Erivanskaya, L. A. and Shuikin, N. I., *Azerbaidzhan Khim Zhur.*, 1961, No. 3, p. 123.

NEAR ULTRAVIOLET ABSORPTION
SPECTRUM OF 2-5 DICHLOROANILINE
IN THE VAPOUR STATE

THE present communication records the ultra-violet absorption spectrum of 2-5 dichloroaniline in the vapour phase. Its Raman spectrum has been studied by Kohlrausch, Stockmair and Ypsilanti,¹ and recently, we have recorded its infrared absorption in solid phase (unpublished).

The ultraviolet absorption spectrum has been obtained with cells of length 25, 50 and 100 cm. at temperatures in the range of $30\text{-}50^{\circ}\text{C}$. A Beckman Hydrogen lamp served as a source of continuum. The spectra were recorded on Zeiss Q-24 Medium and Hilger large quartz spectrographs. The exposure time varied from 15 minutes to $1\frac{1}{2}$ hours, on Ilford N-40 plates, with a slit width of 25μ . Bands were measured on a Hilger L-76 comparator.

The spectrum lies in the region $3100\text{-}2700\text{ \AA}$ and consists of nearly 70 red degraded bands. The strongest band of the system at 3018.5 \AA (33119 cm^{-1}) has been taken as the 0-0 band.

The molecule 2-5 dichloroaniline can be taken to belong to C_s point-group if the plane of the NH_2 group lies in the molecular plane. The transition involved in the present case is $\text{A}'\text{-A}'$ and is an allowed one.

The observed bands have been analysed in terms of 165, 276, 339, 509, 578, 720, 786 cm^{-1} ground state frequencies and 121, 257, 305, 472, 506, 660, 715, 1003, 1174 cm^{-1} excited state frequencies. Table I gives the correlation between the ground and excited state frequencies along with their visual estimate of intensities in parenthesis.

TABLE I
Ground and excited state frequencies of
2-5 dichloroaniline

Infrared* (Solid)	Raman ¹ (Liquid)	Ultraviolet Absorption (Vapour)	
		Ground State	Excited State
..	168 (3)	165 (3)	121 (2)
..	272 (5)	276 (2)	257 (4)
..	328 (7)	339 (1)	305 (4)
..	409 (1)	509 (0)	472 (4)
..	578 (4)	578 (0)	506 (6)
720 (1.5)	704 (10)	720 (0)	660 (8)
786 (3)	..	786 (0)	715 (2)
1038 (1.2)	1032 (7)	..	1003 (4)
1270 (1.5)	1262 (4)	..	1174 (3)

* Authors' unpublished work.

The authors are grateful to Dr. I. S. Singh and Dr. R. N. Singh for their valuable suggestions and criticism during the course of the work. One of us (S. N. Singh) is also thankful to C.S.I.R. (New Delhi) for financial assistance.

Department of Spectroscopy, S. N. SINGH.
Banaras Hindu University, N. L. SINGH.
Varanasi-5, December 14, 1965.

1. Kohlrausch, K. W. F., Stockmair, W. and Ypsilanti, G. P., *Monatsh für Chemie*, 1936, **67**, 80.

MAGNETIC SUSCEPTIBILITY OF A MIXED VALENCE COPPER COMPLEX OF MERCAPTO SUCCINIC ACID

COPPER (II) was reported¹⁻³ to form a deep violet-coloured complex with mercapto succinic acid CH_2COOH . CHSHCOOH (abbreviated MSA). An indication of the mixed valence state suggested by its unusually deep colouration was obtained in amperometric measurements made by Klotz *et al.*,¹ and by potentiometric study made by Cheney, Fernando and Freiser.² The peculiar interest in regard to its mixed-valence nature prompted the present efforts to isolate the complex into solid state and study its magnetic properties. Mercapto succinic acid appears to reduce Cu (II) to Cu (I) and the complex formed is a mixed-valence complex of copper.

50 ml. of 0.1 M copper sulphate were treated with excess of 0.1 M mercapto succinic acid, pH of the complex being kept at 3.5. The mixture was then shaken thoroughly with acetone when a grey-coloured solid began to settle down. It was allowed to stand for about three hours for complete precipitation. The complex was filtered and washed thoroughly, first with acetone and then with ether. It was subsequently dried in an oven at 45° C. (yield 0.98 gm.). It decomposes above 300° C.

The complex is insoluble in water and does not dissolve in organic solvents. Magnetic susceptibility measurements in powder form of the compound shows it to be paramagnetic with μ_{eff} (uncorrected) equal to 2.13 B.M. at 30.5° C.

Copper (34.0%) and sulphur (13.7%) estimations in the solid complex show it to have 5 : 4 :: Cu : MSA composition. Magnetic measurements give a value (2.13 B.M.) higher than that for one unpaired electron. The electron configuration of Cu atom (atomic no. 29) is $3d^{10} 4s^1$ and therefore univalent compounds would be expected to show diamagnetism, being two or four covalent, using linear sp or tetrahedral sp^3 bonds. Cu(II), however, con-

tains one unpaired electron and would be paramagnetic^{4,5} being four-co-ordinated with $3d 4s 4p^2$ (after promoting a $3d$ electron to $4p$) or $4s 4p^2 4d$ hybridisation resulting square planar disposition. Nyholm⁶ reported the μ_{eff} value of the blue and brown cuprous-cupric complexes of methyl-diphenyl arsene to be 1.9₅-2.1₇ B.M. The present investigation gave an uncorrected value within the range of those observed by Nyholm, it seems to confirm that the complex does contain at least one cupric atom per molecule and it would have spin-free tetrahedral ($4s 4p^3$) structure.

The authors are thankful to the Council of Scientific and Industrial Research, New Delhi, for the award of a Fellowship to one of them (S. C. S.). Thanks are also due to Messrs. Evans Chemitics, Inc., New York, for supply of mercapto succinic acid as a gift sample.

Chemical Laboratories, S. C. SINHA.
University of Allahabad, H. L. NIGAM.
Allahabad (India), August 9, 1965.

1. Klotz, I. M., Czerlinski, G. H. and Fiess, H. A., *J. Am. Chem. Soc.*, 1958, **80**, 2920.
2. Cheney G. E., Fernando, Q. and Freiser, H., *J. Phys. Chem.*, 1959, **63**, 2055.
3. Nigam, H. L., Kapoor R. C., Kapoor, U. and Srivastava, S. C., *Viz. Pari. Anu. Patrika*, 1964, **7** (1), 43.
4. Pauling, L., *Nature of Chemical Bond*, University Press, N.Y., Ind. Edn., 1945.
5. Ray, P. R. and Sen, D. C., *J. Indian Chem. Soc.*, 1936, **13**, 138.
6. Nyholm, R. S., *J. Chem. Soc.*, 1951, p. 1767.

PENTA-CO-ORDINATED COBALT (II) COMPLEXES

A CO-ORDINATION number of five is less common in complex compounds. In this communication, we report dihalo-tris-thiourea cobalt (II) complexes and to our knowledge these are the first examples of penta-co-ordinated cobalt (II) complexes with sulphur co-ordination.

Alcoholic solutions of cobalt halide and thiourea in 1 : 3 proportion were mixed and refluxed for one hour. The resulting solution was concentrated and cooled with vigorous stirring in an ice-bath after adding chloroform. Deep blue crystalline compound separated out, filtered, washed with chloroform and dried *in vacuo*. Cobalt was estimated by standard method. Halogen estimation as AgCl could not be carried out due to the interference of thiourea. Conductance and magnetic susceptibility measurements on these compounds were also carried out and the results are given in Table I,

TABLE I

Compound	Formulae	M.P.	% Cobalt		Λ_m in nitrobenzene (mhos)	$\mu_{\text{eff.}}$ (B.M.)	No. of unpaired electrons
			Found	Reqd.			
1. Di chloro tris-thiourea cobalt (II)	$[\text{Cotu}_3\text{Cl}_2]_0$	113° C.	16.3	16.4	0.59	4.18	3
2. Dibromo-tris-thiourea cobalt (II)	$[\text{Cotu}_3\text{Br}_2]_0$	109° C.	13.1	13.1	0.38	4.13	3

It is thus clear that the analyses of the compounds agree with the formulae Cotu_3X_2 ($\text{X} = \text{Cl}$ or Br). They are non-electrolytes, monomeric and paramagnetic indicating 3 unpaired electrons. Hence, they are definitely five-co-ordinated cobalt (II) complexes involving the use of $4s4p^34d$ bonding orbitals. According to the arguments advanced by Daudel and Bucher,¹ the use of $(n-1)d\ ns\ np^3$ bonding orbitals gives rise to a square pyramid whereas $nsnp^3nd$ bonding orbitals result in a trigonal bipyramidal arrangement and hence these compounds are expected to prefer the latter configuration.

Dept. of Chemistry, K. C. DASH.
Regional Engineering College, D. V. RAMANA RAO.
Rourkela-8 (Orissa), August 3, 1965.

1. Daudel, M. R. and Bucher, A., *J. Chim. Physique*, 1945, 42, 6.

CONDUCTOMETRIC ESTIMATION OF COPPER WITH RESACETOPHENONE-OXIME

RESACETOPHENONE-OXIME was used by Neelakantam and Raju¹ for the gravimetric estimation of copper in presence of cadmium. Copper² was titrated amperometrically with the reagent by the author. The present investigation deals with the conductometric titration of copper as acetate with resacetophenone-oxime.

Solutions of copper acetate containing 1-20 mg. were placed in 100 ml. beaker. In each case the volume was kept constant at 70 ml. and the contained alcohol ranged from 20 to 45% depending upon the copper content. The conductivity cell, dip-type (Philips Bridge Model 9500) which was freshly platinized and cleaned was placed in the beaker. Standard solution of the oxime (0.0569 M) was run down from the burette (10 ml). After each addition the solution was stirred using a magnetic stirrer, the resistance was recorded and conductance calculated. The conductance decreased till the end-point and later became almost constant. The values were corrected for volume change and plotted against the volume of the reagent. The end-point was determined graphically. The molar ratio (1 : 2)

of copper to reagent was established in amperometric estimation of copper.²

Amounts of copper ranging from 5 to 20 mg. could be determined with $\pm 1\%$ error keeping the alcohol content of the solution at 35-45%. With small amounts of copper the alcohol content should be reduced to 20-35% in order to obtain results with the same orders of accuracy.

Chemistry Department, Y. KRISHNA REDDY.
S.V. University,
Tirupati (A.P.), September 24, 1965.

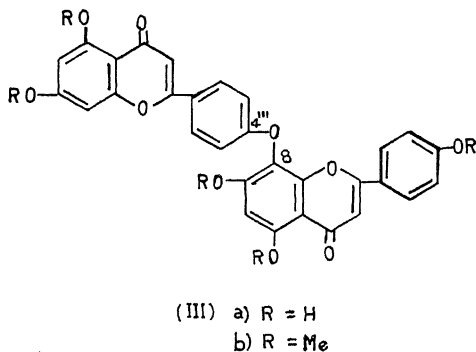
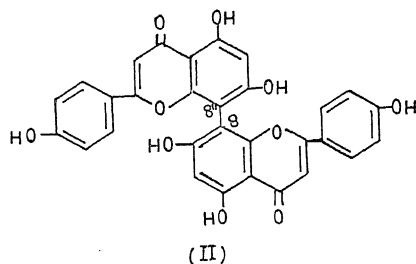
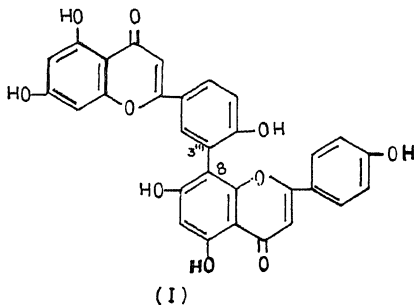
1. Appala Raju, N. and Neelakantam, K., *Curr. Sci.*, 1950, 19, 383.
2. Krishna Reddy, Y., *Proc. Ind. Acad. Sci.*, 1965, 61 A, 368.

SYNTHESIS OF HINOKIFLAVONE PENTAMETHYLETHER

THE naturally occurring biflavonols belong to two major groups: the biphenyl types represented by amentoflavone (I)^{1,2} and cupressuflavone (II)^{3,4} and the biphenyl ether type of which hinokiflavone (III a)^{1,5} is the only example. Recently it has been reported that dimers of flavonols occur in gymnosperms.⁶ A number of methylethers of amentoflavone^{1,3,5} and two methylethers of hinokiflavone⁷ also occur but no methylether of cupressuflavone is yet known. The structures of the biphenyl type of biflavonols have been confirmed by synthesis^{8,9} but that of hinokiflavone type has been deduced only from analytical and degradative evidence¹⁰ and has not so far been confirmed by synthesis. We now report the synthesis of hinokiflavone pentamethylether (III b).

The starting materials for this synthesis are 8-iodoapigenin trimethylether⁸ and 5, 7-dimethoxy-4'-hydroxyflavone.¹⁰⁻¹² The latter compound has now been prepared by selenium dioxide oxidation of 2', 4'-dihydroxy-4', 6'-dimethoxychalcone.¹³ The 8-iodoapigenin trimethylether and the potassium salt of 5, 7-dimethoxy-4'-hydroxyflavone have been condensed under Ullmann conditions. The resulting product gave a positive ferric reaction showing that demethylation had taken place during the condensation; similar observation was also made

by Nakazawa in the synthesis of 8,8'-biapigeninyl hexamethylether (personal communication). The crude reaction product was methylated and on paper chromatography (toluene-acetic acid, 25 : 1 v/v and 25 : 2 v/v) was found to be a mixture of apigenin trimethylether,



8-iodoapigenin trimethylether, cupressuflavone hexamethylether and hinokiflavone pentamethylether. Two methods were used to isolate the hinokiflavone pentamethylether from this mixture: chromatography on Whatman 3 MM paper (toluene-acetic acid, 25 : 1 v/v, fluorescence in ultra-violet light being employed to locate the compounds) and chromatography on silica gel column using first chloroform and then benzene

for elution. From the benzene eluate hinokiflavone pentamethylether was obtained and was further purified by crystallisation from methanol. The identity of the synthetic compound with natural hinokiflavone pentamethylether was established by paper chromatography (circular R_f, 0.3 in toluene-acetic acid, 25 : 1 v/v at 30° and 0.7 in toluene-acetic acid, 25 : 2 v/v at 30°), cochromatography with an authentic sample (ascending in the same solvent systems, characteristic violet fluorescence of the rings and the spots in U.V. light), U.V. absorption ($\lambda_{\text{max}}^{\text{EtOH}}$, 265 m μ , log ϵ , 4.5; 326 m μ , log ϵ , 4.7), m.p. and mixed m.p. (260-62°).

A variety of conditions for the Ullmann condensation were investigated but the yields of the hinokiflavone pentamethylether were poor, cupressuflavone hexamethylether being obtained in slightly better yields; major amounts of apigenin trimethylether and 8-iodoapigenin trimethylether were recovered from the reaction mixtures.

We are grateful to Prof. S. Shibata and Dr. K. Nakazawa for the copper catalyst and to Dr. N. Kawano for a sample of hinokiflavone pentamethylether.

Department of Chemistry, S. K. KRISHNAN.
Delhi University, V. V. S. MURTI.
Delhi-7, September 28, 1965. T. R. SESHADRI.

1. Kawano, N., in *Recent Progress in the Chemistry of Natural and Synthetic Colouring Matters and Related Fields*, Ed. T. S. Gore, B. S. Joshi, S. V. Sunthakar and B. D. Tilak, Academic Press, 1962, p. 177.
2. Baker, W., Finch, A. C. M., Ollis, W. D. and Robinson, K. W., *J. Chem. Soc.*, 1963, p. 1477.
3. Murti, V. V. S., Raman, P. V. and Seshadri, T. R., *Tetrahedron Letters*, 1964, p. 2995.
4. —, —, *Proceedings of the Symposium on Recent Advances in Plant Polyphenolics*, National Institute of Sciences of India, New Delhi, October 1964.
5. Baker, W. and Ollis, W. D., in *Recent Developments in the Chemistry of Natural Phenolic Compounds*, Ed. W. D. Ollis, Pergamon Press, 1961, p. 152.
6. Loth, H., Klinge, D. and Heinrici, K., *Chem. Abs.*, 1965, **62**, 5584.
7. Kawano, N., Miura, H. and Waiss, A. C. Jr., *Chem. and Ind.*, 1964, p. 2020.
8. Nakazawa, K., *Chem. Pharm. Bull.*, 1962, **10**, 1032.
9. — and Ito, M., *Ibid.*, 1963, **11**, 283.
10. Mahal, H. S. and Venkataraman, K., *J. Chem. Soc.*, 1926, p. 569.
11. Nordström, C. G. and Swain, T., *Ibid.*, 1953, p. 2764.
12. Heitz, S., Mentzer, C. and Heim, R., *C.R. Acad. Sci.*, 1961, **252**, 4214.
13. Guider, J. M., Simpson, T. H. and Thomas, D. B., *J. Chem. Soc.*, 1955, p. 170.

PIGMENTS FROM *PENICILLIUM HERQUEI*

Part II.* Conversion of Herqueinone to Atrovenetin

ATROVENETIN was first isolated from *Penicillium atrovenitum* by Raistrick *et al.*¹ Later it was shown to be produced by the closely related species *Penicillium herquei* along with herqueinone and was found to be the component responsible for the antibiotic activity.² The antibiotic spectrum of atrovenetin has recently been reported.³ The association of the antibiotic activity with the perinaphthenone structure is indicated by the antibiotic activity of deoxyherqueinone⁴ (atrovenetin monomethyl ether). While the structure of atrovenetin is established,⁵ that of herqueinone is not fully understood.⁶ Thus the methods of interconversion in this group of compounds provide a means of converting the inactive herqueinone derivatives to active atrovenetin derivatives and are also useful in the understanding of the chemistry of these compounds.

Herqueinone and norherqueinone yield the deoxy derivatives by zinc-acetic acid reduction and deoxynorherqueinone is identical with atrovenetin.⁵ Herqueinone has now been directly converted to deoxy herqueinone acetate by reductive acetylation with zinc, acetic acid and acetic anhydride. The product is identical with the deoxyherqueinone acetate obtained by acetylation of deoxy herqueinone. This method has an advantage over the method of direct reduction of herqueinone in that the green or blue-coloured pigments are not formed and the yields are higher.

Herqueinone and norherqueinone are unstable in acid solutions and are readily converted into the xanthoherquein and xanthonorherquein,^{6,7} while atrovenetin is stable in acid solutions. The stability is attributed to the aromatisation of rings A and B. Deoxy herqueinone on demethylation with hydriodic acid in acetic anhydride gave atrovenetin in good yields. Herqueinone when subjected to direct reductive demethylation using zinc, acetic anhydride and hydriodic acid gave good yields of atrovenetin. The reductive demethylation could be carried out with the same results, with or without glacial acetic acid in the mixture. Direct demethylation of herqueinone with hydriodic acid in acetic anhydride solution gave a product (yet unidentified) different from atrovenetin. The IR spectrum of this compound indicates the absence of naphthalene system present in atrovenetin. (Two bands at 920 and 870 cm.⁻¹)

Experimental.—The melting points are uncorrected. The UV spectra were taken on Beckman model D.B. Spectrophotometer and the IR Spectra on Perkin-Elmer model 237 Spectrophotometer.

Reductive acetylation of herqueinone (deoxy herqueinone diacetate).—Herqueinone (200 mg.) was dissolved in acetic anhydride (5 ml.), glacial acetic acid (2 ml.), zinc dust (40 mg.) and pyridine (1 ml.) were added and the mixture heated on a boiling water-bath for 1 hour. It was then filtered and the residue washed with acetic acid (2 ml.). The filtrate was poured into excess of ice-cold water (100 ml.) and the solid filtered and washed with water. It crystallised from alcohol as yellow plates melting at 173°. It was identical with deoxyherqueinone diacetate obtained from deoxy herqueinone (mixed melting point, UV and IR spectra). Yield 200 mg.

Demethylation of deoxy herqueinone (atrovenetin).—To deoxy herqueinone (200 mg.) in acetic anhydride (1.0 ml.) was added hydriodic acid (4 ml. sp.gr. 1.7) and the mixture refluxed at 140° for 1 hour. It was then cooled and poured into a solution of sodium bisulfite (2%) in water (50 ml.). The yellow solid was filtered, washed with water and crystallised from methanol. It separated from methanol as yellow prisms melting at 290° d. It gave a dark brown colour with ferric chloride, in alcoholic solution. It was identical with atrovenetin in all its properties including antibacterial activity (mixed m.p., UV and IR spectra).

Reductive demethylation of herqueinone.—Herqueinone (200 mg.) in acetic anhydride solution (1 ml.) was treated with zinc dust (25 mg.) and hydriodic acid (4 ml.) with cooling. The mixture was refluxed at 140° C. for 1 hour and then worked up as described above and crystallised from methanol. It was identical with atrovenetin (m.p., mixed m.p., UV and IR spectra).

In another experiment herqueinone (200 mg.) in acetic anhydride (1 ml.) and acetic acid (1 ml.) was treated with zinc and hydriodic acid. The product when worked up as before was identical with atrovenetin.

Demethylation of herqueinone with hydriodic acid.—Herqueinone (200 mg.) was refluxed with hydriodic acid (4 ml.) in acetic anhydride solution (2 ml.) at 140° for 2 hours. The product was worked up by pouring the mixture in sodium bisulfite solution. On crystallising from methanol it was obtained as yellow microcrystalline solid, decomposing above 300°. It gave a deep brown colour with ferric chloride

in alcoholic solution. Its UV spectra showed maxima at 435, 365, 275 and 220 m μ and the infra-red absorption bands were at 3300, 1615, 1250, 1080 and 968 cm.⁻¹

Antibiotics Research Centre, N. NARASIMHACHARI.
Hindustan Antibiotics Ltd., B. S. RAMASWAMI.
Pimpri, Poona-18, October 1, 1965.

* Part I : Ref. 2.

1. Raistrick, H. and Neil, K. G., *Chem. Ind.*, 1956, p. 551.
2. Narasimhachari, N., *et al.*, *Can. J. Microbiol.*, 1963, 9, 134.
3. —, *et al.*, *Proc. Ind. Acad. Sci.*, 1965, 61B, 160.
4. —, *Experientia*, 1965, 21, 376.
5. Barton, D. H. R., *et al.*, *Tetrahedron*, 1959, 6, 48.
6. Cason, J., *et al.*, *Ibid.*, 1962, 18, 839.
7. Harman, R. E., *et al.*, *J. Org. Chem.*, 1955, 20, 1260.
8. Gallaraga, J. A., *et al.*, *Biochem. J.*, 1955, 61, 456.

CYCLOMORPHOSIS IN A PLANKTON ROTIFER *KERATELLA TROPICA* APSTEIN

CYCLOMORPHOSIS can be defined as cyclic form change in a series of genetically identical generations.¹ This phenomenon is common in some species of dinoflagellates, rotifers and cladocerans. Recently Yeatman² has pointed out the existence of cyclomorphosis in a copepod. Among the rotifers, in Brachionidae and specially in *Keratella* this phenomenon is widespread notably in the two European species *K. quadrata*

and *K. cochelearis*. Green³ has given an account of the variations in the posterior spine of a tropical rotifer *K. tropica* from north Nigeria. His observations were on the species collected from a pool, which is isolated from the main channel of the river Sokota, when the floods subside. The same species *K. tropica* was available from a fish pond in Delhi and the cyclic changes in this species were studied. The results showed differences and similarities from that reported earlier.³

The rotifers were collected from Roshanara Tank. An account on the ecology of the tank, with special reference to the presence of a permanent algal bloom has already appeared.⁴ Collection of rotifers was made fortnightly by filtering 20 litres of water through a plankton net made of Bolting Silk No. 21. Samples were obtained for a period of one year from October 1958 to September 1959.

The procedure given by Green³ for measuring the length of the lorica and the spines was followed in the present study. The number of rotifers measured varied depending upon the availability of the specimens. However, the minimum number of rotifers examined at any time was 28 and the maximum 50.

There were no specimens of *K. tropica* in the collections of October 1958. From November onwards they were present till the middle of July 1959 but again they were absent in the two samples of July and August. In Table I

TABLE I
Variation in the length of lorica and spine in *K. tropica*

Date	Mean length of lorica μ	Mean length of left posterior spine μ	Mean length of right posterior spine μ	Correlation coefficient (r) between lorica and left spine	Correlation coefficient (r) between lorica and right spine	Correlation coefficient (r) between right and left spine	Number of observations
3 Nov. 1958	90.92	3.98	53.88	+0.454	+0.651	+0.763	47
23 Nov. 1958	98.80	4.68	66.46	+0.116*	+0.434	+0.232*	50
11 Dec. 1958	93.03	3.76	58.76	-0.344	-0.554	+0.417	35
30 Dec. 1958	95.93	3.60	64.06	+0.057*	+0.516	+0.732	37
13 Jan. 1959	101.36	1.63	74.73	-0.281	+0.014*	+0.002	50
30 Jan. 1959	101.00	0.80	71.10	-0.018*	-0.188*	+0.159	50
14 Feb. 1959	96.03	6.63	71.06	+0.288	+0.392	+0.573	50
26 Feb. 1959	95.80	5.90	73.03	+0.342	+0.592	+0.203*	50
14 Mar. 1959	95.53	7.16	73.03	+0.330	+0.646	+0.716	50
30 Mar. 1959	89.02	2.30	56.68	+0.531	+0.846	+0.305	50
14 April. 1959	94.83	5.64	70.13	+0.496	-0.393	+0.567	28
28 April. 1959	88.33	7.73	66.90	-0.012*	-0.142*	+0.697	30
5 May 1959	90.30	4.00	58.06	+0.511	+0.306*	+0.048	30
28 May 1959	92.90	13.10	71.36	-0.101*	-0.212*	+0.616	30
13 June. 1959	93.10	1.73	54.50	+0.280*	-0.917	+0.665	30
29 June. 1959	95.23	2.80	53.10	+0.128*	+0.466	+0.304*	35
12 July. 1959	92.86	1.50	38.63	+0.405	+0.585	+0.574	30
30 July. 1959	..	..	..	..	..	..	..
12 Aug. 1959	..	..	..	..	..	..	..
28 Aug. 1959	90.50	2.16	53.96	-0.059*	-0.042*	+0.316*	30
14 Sept. 1959	88.46	3.46	48.76	-0.091*	-0.115	+0.510	30
29 Sept. 1959	88.40	5.26	55.26	-0.033*	+0.259	+0.582	30

* Values not significantly different from 0 (at the 5% level of significance).

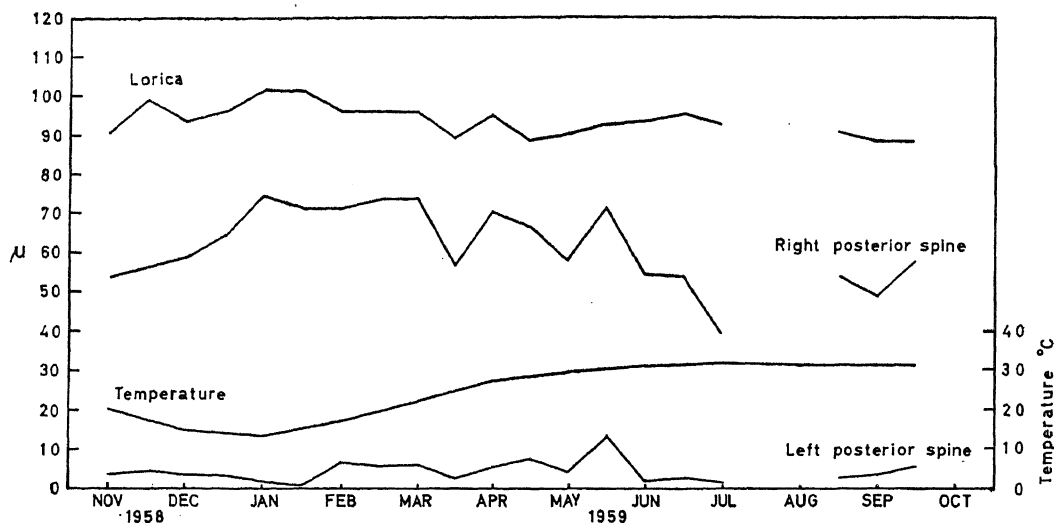


FIG. 1. Variations in the dimensions of *Keratella tropica* and water temperature.

the variations in the length of lorica and spines in twenty samples are given. Unlike the observations of Green,³ the right posterior spine was not always positively correlated with lorica. On three occasions there were significant negative correlations while on eight occasions there were no correlations. Similarly significant negative correlations were obtained between lorica and left spine twice and no correlations on ten occasions. It is interesting to find that there was always a positive correlation between right and left spine and most of the times it was significant. From the analysis no definite conclusions can be drawn.

The variations in the length of the lorica, left and right spine and the temperature of water are shown in Fig. 1. The points marked are indicative of fortnightly samples and do not necessarily correspond to the dates. In *K. tropica* large variation in the left spine was noted while the right spine remains fairly constant.³ However, in the present study the length of the right and left spines of *K. tropica* showed considerable variations in different samples. Also the changes in the length of the left spine did not follow any definite pattern as pointed out by Green.³ It is seen from Fig. 1 that there is no relation between temperature of water and spine length in *K. tropica*. A positive correlation was established between temperature and posterior spine length in *K. cochlearis*.⁵

It is surprising that no data are available on cyclomorphosis in rotifers from India. From the present study it is evident that there are differences in the cyclomorphosis of the same

species *K. tropica* in different geographical regions. The factors responsible for the cyclic form changes in rotifers are not clearly understood till now. Observations on the phenomenon from natural populations and under experimental conditions on the same species may provide more information on the subject.

Central Public Health M. G. GEORGE.
Engineering Research Institute,
Chandrawal Water Works No. 2,
Delhi-6, July 7, 1965.

1. Brooks, J. I., *Ecol. Monogr.*, 1946, **16**, 409.
2. Yeatman, H. C., *J. Elisha Mitchell sci. Soc.*, 1959, **75**, 154.
3. Green, J., *Proc. zool. Soc. London*, 1960, **135**, 491.
4. George, M. G., *Proc. Ind. Acad. Sci.*, 1962, **56**, 354.
5. Gallagher, J. J., *Trans. Amer. micr. Soc.*, 1957, **76**, 197.

A NOTE ON THE FINDING OF VERTEBRATE FAUNA IN THE SURMA SERIES OF TRIPURA AND ITS BEARING ON THE STRATIGRAPHY OF THE AREA

THE note records for the first time the occurrence of mammalian fauna in the Surma Series of Tripura. Some mammalian, piscine and reptilian fossils were collected by the author from the conglomerate beds occurring within the Boka Bil Stage from (1) about 9 km. west of Teliamura (23° 50' 20" : 91° 38' 30") and (2) Narengbari (23° 47' 15" : 91° 33' 45") in the Bar Mura range, Tripura.

The fossils reported earlier from the Surma Series by Pinfold, Eames, Mukerjee and Das

from Kanchanpur (Sylhet District), Garo Hills and Tripura include lamellibranchs, gasteropods, foraminifers, pisces and reptiles which have wide vertical distribution. After study of the fossils from the Garo Hills and Kanchanpur and their correlation with the fauna of other parts of India and Burma, Mukerjee has surmised the age of the Bhuban to be Chattian to Aquitanian and Boka Bil to be Aquitanian to Burdigalian.

The fossils collected by the author, however, do not confirm the age of Aquitanian to Burdigalian for the Boka Bil Stage. The following fossils have been identified by the author :

Pisces :

1. *Oxyrhina spallanzanii*.
2. *Oxyrhina* sp.
3. *Oxyrhina* cf. *pagoda*.
4. *Prinodon gangeticus*.
5. *Siluroid* gen.

Reptilia :

1. *Crocodylus palustris*.
2. *Gharialis gangeticus*.
3. *Gharialis* cf. *gangeticus*.
4. *Gharialis* sp.

Mammalia :

1. *Trilophodon angustiden*.
2. *Dorcatherium* sp.

This assemblage reveals an upper Miocene age for the Boka Bil Stage. *Trilophodon angustiden* found in the Manchar Series of north-western India and *Dorcatherium* found in the Chingi Stage of Siwalik indicate a Tortonian age for the conglomerate bed in which these fossils have been found. Since this fossiliferous conglomerate bed occurs high up in the Boka Bil Stage this stage may extend downward to Helvetian.

I am thankful to Dr. M. R. Subramanyam, Shri N. V. A. Shastri and Shri P. P. Satsangi, for help and co-operation in course of the work.

Geological Survey of India, A. N. TRIVEDI.
Assam Circle, Shillong-3.
August 27, 1965.

1. Hora, S. L., *Rec. G.S.I.*, 1937, 72 (2), 174.
2. Lyddekarr, R., *Pal. Ind. Ser. X*, 1887, 3, 241.
3. Mukerjee, P. N., *Pal. Ind. New. Ser.*, 1939, 28.
4. Noetting, F., *Pal. Ind. Nes. Ser.*, 1901, 1, pt. 3.
5. Woodward, A. S., *Cat. fossil fish. Brit. Mus.*, 1901.
6. Vachell, E. T., *Q. J. Geol. Min. and Met. Soc. Ind.*, 1942, 14 (1), 9.

SPHENOPTERIS SAKRIGALIENSIS
SP, NOV., A FERN FROM THE
RAJMAHAL HILLS, BIHAR

In the present note, a new species of *Sphenopteris*, *S. sakrigaliensis*, is described from the Sakrigalighat fossil locality (25° 15' N.; 87° 43' E.), about 1 mile north of Sakrigali railway station and a few yards west of Sakrigalighat ferry station. Five intertrappean beds are exposed in this locality, two of which are richly fossiliferous. The bed from which the present specimens were collected is a hard procelanic shale, whitish grey in colour and about 2 ft. in thickness. This bed is full of leaf-impressions of *Ptilophyllum*, *Pterophyllum*, *Nilssonina*, *Brachyphyllum* and *Elatocladus*. *Protocyathea rajmahalense* Jacob¹ and *Williamsonia santalensis* Sitholey and Bose² were also collected from this bed.

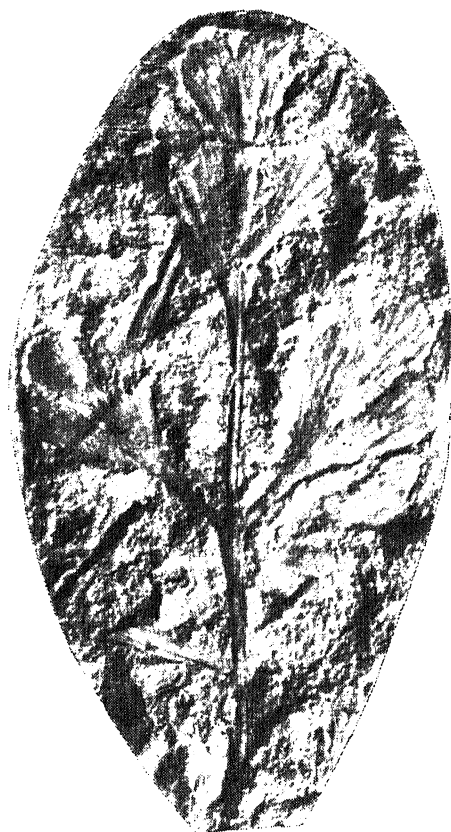


FIG. 1.

The present material consists of several fragmentary but well-preserved specimens. One of the specimens shows sufficient details on which this new species is based.

Sphenopteris sakrigaliensis SP. NOV.

Description.—Habit unknown, for description assumed to be ? bipinnate; detached pinnae 3.5 cm. in length, imparipinnate; rachis slender, measuring 1 mm. or more, sometimes distinctly ridged, bearing opposite pinnules. Pinnules somewhat thick, about 1 cm. or more in length and up to 7 mm. across, distinctly lobed, lobes \pm club-shaped, usually 3 in number, apex of pinnules broadly rounded, tapering down to form a fairly long and narrow base, usually 2 to 4 mm. in length; venation of the *Sphenopteris* type, lateral nerves forking once or twice.

This species is characterized by having pinnules deeply incised into 2 to 3 club-shaped lobes and a long and narrow base. In this character it distinguishes itself from all the other known species of *Sphenopteris* and hence described as a new species. It is named after the locality 'Sakrigalighat'.

Holotype.—Figure 1, Specimen No. 4582 of the Birbal Sahni Institute of Palaeobotany Museum.

Locality.—Sakrigalighat, Santhal Parganas, Bihar, India.

Horizon.—Rajmahal Intertrappean Series (Jurassic).

The author is grateful to Dr. R. N. Lakhanpal for going through the manuscript.

Birbal Sahni Institute of S. C. D. SAH.

Palaeobotany,
Lucknow, August 10, 1965.

1. Jacob, K., *Proc. Ind. Acad. Sci.*, 1937, 6 (2).
2. Sahoo, R. V. and Bose, M. N., *Palaeobotanist*, 1952, 2.

**TETRAPHYLLIDEAN LARVA
(CESTODA) IN THE COPEPOD,
EUCALANUS SUBCRASSUS
GIESBRECHT, 1888 OFF WALTAIR
COAST, BAY OF BENGAL**

CESTODE larvae of the type *Scolex pleuronectis* are characteristic of Tetracyllidae which as adults inhabit the spiral valves of elasmobranch fishes. Such larvae have been reported to occur in a variety of hosts like copepods, ctenophores, decapod crustaceans, molluscs and teleosts.¹⁻³ More recently Dollfus⁴ enumerated the cestodes occurring in planktonic organisms and other marine invertebrates. The relative importance of these potential intermediate hosts is not completely clear. It has been suggested that copepods may form the usual first intermediate hosts and the life-history may be comparable to that in Pseudophyllidae.¹ In Tetracyllidae, the larva in the copepods is in most cases with-

out a cercomer and it is usual to find these larvae without appreciable further development in the gut of teleosts.^{3,5,6} However, the larvae have also been encountered in the muscles of fishes.³ In an experimental study Riser⁷ described a 15-day old proceroid of *Acanthobothrium hispidum* in the copepod, *Tigriopus fulvus* (Fisher). He was able to note a cercomer with two pairs of hooks in the proceroid and stated that calcareous bodies make it difficult to search for the hooks.

It would appear that two conditions exist in Tetracyllidae. Usually the larvae in the copepods are able to reach the plerocercoid level and hence are without cercomers. These larvae upon reaching the gut of teleost remain in the lumen. In the second case, which presumably is infrequent, the cercomers may be present at the time the larvae are ingested by the teleost in which case they penetrate the gut wall, reach the muscles and become plerocercoids. It is stated that in Pseudophyllidae the cercomer would be lost in the stomach of fish host before the larva gains entrance into the body cavity. Frontal glands are thought to be involved in the process of penetration of the gut.¹ At present there does not seem to be any information on this aspect in Tetracyllidae.

During our studies on helminth parasites of planktonic organisms we had encountered a copepod, *Eucalanus subcrassus* heavily infected with unencysted *Scolex pleuronectis* of the unilocularis type. The organisation of the larva in general conforms to the already available description⁸ except for the number of calcareous bodies. The present specimens contain 3 large and 2 small calcareous bodies (Fig. 1). It has been possible to follow some details pertaining to osmoregulatory system. There are two longitudinal canals (L) which meet a little distance from the posterior end and after the formation of a small vesicle (V) a median stem (M) runs to the posterior extremity of the larva. A short distance before the two canals meet they are connected by a transverse canal (T). Two pairs of active flame cells (FC) could be seen. One pair is situated at the level of the transverse canal and the other pair at the anterior end behind the suckers. Both these pairs are appended to the longitudinal canals. To the authors' knowledge this type of osmoregulatory system has not been reported so far and there are few reports on the occurrence and distributional pattern of flame cells in cestode larvae.^{9,10}

One of us (R. M.) thanks the C.S.I.R. for a Junior Fellowship. Our grateful thanks are due

to Prof. P. N. Ganapati for interest and encouragement.

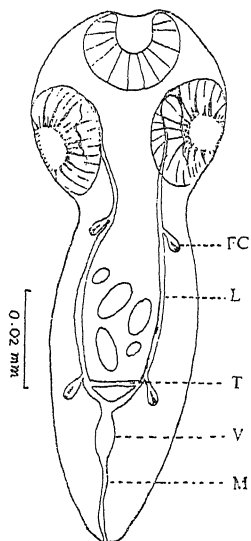


FIG. 1. Tetraphyllidean larva FC. Flame cell, L. Longitudinal canal, T. Transverse canal, V. Vesicle, M. Median stem.

Department of Zoology, K. HANUMANTHA RAO.
Andhra University, R. MADHAVI.
Waltair, August 6, 1965.

1. Hyman, L. H., *The Invertebrates. Vol. II—Platyhelminthes and Rhynchocoela*, McGraw-Hill Publications, 1951.
2. Wardle, R. A. and McLeod, J. A., *Zoology of Tapeworms*, The University of Minnesota Press, 1952.
3. Sita Anantaraman, *Z. f. Parasitenkunde*, 1963, 23, 309.
4. Dollfus, R. P., *Ann. Parasit.*, 1964, 39, 329.
5. Yamaguti, S., *Systema Helminthum. Vol. II—Trematodes of Vertebrates*, Interscience Publishers, 1959.
6. Hutton, R. F., *Bull. mar. Sci. Gulf and Caribb.*, 1961, 11, 309.
7. Riser, N. W., *Proc. helm. Soc. Wash.*, 1956, 23, 120.
8. Sita Anantaraman and Krishnaswamy, S., *J. Zool. Soc. India*, 1958, 10, 1.
9. Hutton, R. F., Sogandares-Bernal, F., Eldred, B., Ingle, R. M. and Woodburn, K. D., *Fla. St. Bd. Cons. Tech. Ser.*, 1959, 26, 1.
10. Kruse, D. N., *Tulane Stud. Zool.*, 1959, 7, 123.

FAT AND CARBOHYDRATE LEVELS IN *MARTESIA FRAGILIS* IN RELATION TO SEX CHANGE

It is known that *Martesia fragilis*, the wood-boring pholad, is stenomorphic and exhibits a sex change from a protandrous to a protogynous condition through a hermaphroditic stage.¹ During a study of the chemical constituents of *M. fragilis* Srinivasan²⁻⁴ reported that the fat and glycogen levels are not size dependent and

are influenced by the gonadal activity and nutrition. The interrelationships between these two chemical constituents accumulated during the early and late sexual phases in its life-history in relation to their nature and significance are reported here.

Estimations of fat and carbohydrate content are made using techniques reported earlier.^{5,6} It was observed that there was no relationship between fat and body size during growth stages (Table I). The immature and male *Martesia*

TABLE I

	Wet weight mg.	Glycogen %	Mean %	Wet weight mg.	Fat %	Mean %
Spent						
Immature or	10.00	3.25		19.17	12.6	
Male phase	17.35	2.84	2.77	29.50	16.0	
	41.50	2.22		30.20	13.9	13.24
				36.00	12.1	
				68.00	11.6	
Gravid	5.50	5.77				
	10.00	7.10	7.36			
	13.50	9.22				
Female phase	6.00	11.58		23.67	12.4	
	12.50	8.36	9.17	24.00	11.5	11.1
	24.00	7.58		43.90	10.0	
				69.00	10.5	

have greater amount of fat per unit weight than the females. In the young (immature or male phase) the percentage of fat varies from 11.6% to 16% for a range in wet weight of 19.17 to 68.00 mg. while in resting adults (mature female phases) it is 10% to 12.4% for 23.67 to 69.00 mg. of wet weight. It has been noted that in the actively boring *Martesia* the percentage fat is higher and as the animal grows in size and when the adult stage is reached (in the resting condition) there is a fall in the fat content.

The carbohydrate value as estimated by the glycogen content of entire animals in the burrowing phase is low (2.77%) and during growth and sex change into the female phase it rises to 9.17% with a mean of 4.88%.

The glycogen content is on an average higher in females than in males and in gravid females than in spent ones, which may suggest a relation to egg production requiring energy store. It may be inferred that so far as increase in size is concerned pholads which have to depend on plankton filtration may not be in a position to increase their carbohydrate content as much as their protein. The glycogen values of animals other than the gravid and spent ones do not

vary considerably with increase in weight as has been observed in *Teredo* (Lane *et al.*).⁷

It will be seen from the above observations that during growth and sex change the percentage of fat declines during the female resting phase whereas the carbohydrates register a three-fold increase during the same phase resulting in a balanced proportion of these two constituents in the resting adult phase. The high fat content in *M. fragilis* appears to be due to the animal's dependence for nutrition on zooplankton which is richer in fats than in carbohydrates.⁸ The higher fat content in young burrowing forms, compared to glycogen, suggests the possibility of fat forming a considerable part of the metabolic substrate, especially in the young stages when the animals are active borers with higher energy requirements. Also, the above observations are substantiated by the fact that twice as much energy is produced per gram of fat when oxidized as per gram of carbohydrate (Raymont and Conover).⁸

The data presented in Table I show an increase of carbohydrates in maturing forms. This is probably because of the concentration of glycogen in the gonads rather than a uniform increase in all tissues. Hopkins and Hutchinson⁹ in tracing the fluctuations of nitrogen and carbon in parasitic cestodes remark that a fall in the nitrogen level during growth has been considered as a mere reciprocal of the important metabolite which is likely to be glycogen. If this were true, as a general principle, it is supported by the fact that when glycogen concentration increases in the gonads, the nitrogen decreases in the whole animal relative to carbohydrates as has been shown by the author.¹⁰ Hence, it is probable that during growth, sex change and in female phase the glycogen forms an important metabolite.

The fat and carbohydrate levels of *M. fragilis*, a pelagic form in the inshore area, are higher than in *M. striata* an allied species occurring in fixed timber structures of the harbour which is an enclosed area. The differences in the chemical constituents observed in the two species may possibly be due to the provision of greater opportunities for intensive feeding for *M. fragilis* than for *M. striata*. Also, the availability of zooplankton-rich food is expected to be higher in the coastal area than inside the harbour where it will be limited owing to factors like pollution and low oxygen content of sea-water.

Thus, the above observations show that in *M. fragilis* the lipids are more important as

metabolites in the earlier male phase (actively burrowing) when carbohydrate levels are lower. However, as the animals grow and undergo sex change into the female phase (i.e., when the animals have ceased burrowing) the carbohydrates accumulate in larger quantities and are of considerable importance as metabolites.

I am thankful to Prof. G. Krishnan, Director, for helpful suggestions and to the authorities of the Forest Research Institute, Dehra Dun, for providing funds to carry out these investigations. Marine Organisms Scheme, V. V. SRINIVASAN, Zoological Research Lab., University of Madras, August 17, 1965.

1. Srinivasan, V. V., *J. Mar. biol. Ass. India*, 1962, 4 (2), 183.
2. —, *Zool. Jb. Physiol.*, 1964, 70, S. 539.
3. —, *Proc. Ind. Acad. Sci.*, 1963, 57, 124.
4. —, *Life Sciences*, 1963, No. 3, 149.
5. —, Studies on Pholads of Madras, *Ph.D. Thesis, Madras University*, 1961.
6. — and Krishnaswamy, S., *Curr. Sci.*, 1961, 30, 353.
7. Lane, C. E., *et al.*, *Bull. mar. Sci. Gulf. Carib.*, 1952, 2, 385.
8. Raymont, J. E. G. and Conover, J., *Limnology and Oceanography*, 1961, 6 (2), 154.
9. Hopkins, C. A. and Hutchinson, W. M., *Exp. Parasit.*, 1958, 7, 349.
10. Srinivasan, V. V., *Comp. Biochem. Physiol.*, 1963, 9, 31.

IONIC REGULATION IN *MARPHYSA GRAVELYI* SOUTHERN (POLYCHAETA)

IN an earlier paper,¹ it was shown that chlorides are regulated in *Marphysa gravelyi* Southern, a brackish-water Eunicid. Analyses (mean of 10 estimations) of Na and K ions using Zeiss Flame Photometer, show that (Table I) these

TABLE I

Experimental Medium %	Final Body Fluid Concentration in mM/l						
	Values			Ratios			
	Cl	Na	K	Na:Cl	K:Cl	K:Na	(Na+Cl) (K+Cl)
9	301	150	28	1:2	1:11	1:5	1:1.4
11	358	135	24	1:3	1:15	1:5	1:1.3
16	305	90	18	1:3	1:17	1:5	1:1.2
26	464	163	33	1:3	1:14	1:5	1:1.2

ions also are regulated. The Na content of the body fluid ranged from 90 mM/l in worms exposed to 16‰ external salinity to 163 mM/l in worms exposed to 26‰. The K ions ranged from 18 mM/l to 33 mM/l in worms exposed to similar external dilutions. When the ratios are considered, there is a remarkable constancy; for example, the ratios between Cl and Na is

maintained at 1:3; and K at 1:11 to 1:17. The ratios between the Na and K were more constant (1:5) in all dilutions. Considered as (Na + Cl) and (K + Cl), the ratios are maintained at a fairly constant level. These results seem to suggest that there is a regulation of cations and anions in this polychaete, although regulations of these ions were believed to be restricted to Crustacea and Cephalopoda.^{2,3} The mechanism or mechanisms responsible for this regulation although as yet obscure, it is probable that the excretory organs may play an important role. Active uptake of Na and Cl from the medium by the well-developed branchiae cannot be ruled out.

Department of Zoology, B. KRISHNAMOORTHY.
University of Madras, S. KRISHNASWAMY.
Madurai Centre,
Madurai-2 (S. India), August 9, 1965.

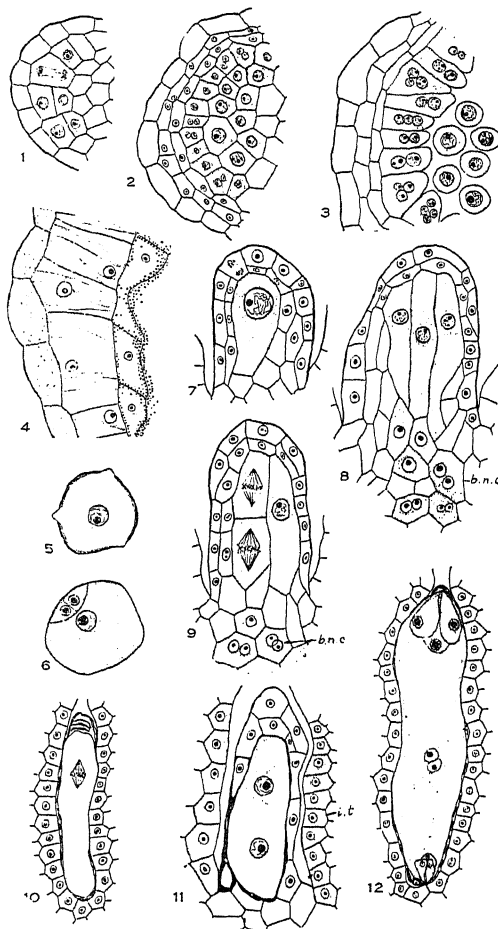
1. Krishnamoorthi, B., *Curr. Sci.*, 1963, **32**, 463.
2. Robertson, J. D., *J. exp. Biol.*, 1953, **30**, 277.
3. —, "Osmotic and ionic regulation in aquatic invertebrates," in *Recent Advances in Invertebrate Physiology*, Ed. B. T. Scheer, University of Oregon Publications, 1957.

SPOROGENESIS AND THE DEVELOPMENT OF GAMETOPHYTES IN *CORDIA ALBA* L.

THE only report so far on the embryology of the genus *Cordia* belonging to the subfamily Cordioideae of the family Boraginaceae is that of Svensson (1925). The present investigation pertains to the microsporogenesis, megasporogenesis and the development of the male and the female gametophytes in *Cordia alba* L.

A young anther consists of a rounded, homogeneous mass of cells, which soon becomes four-lobed. A plate of four to five hypodermal archesporial cells is differentiated in each lobe (Fig. 1). Periclinal divisions in these cells result in the formation of an outer parietal layer and an inner sporogenous layer (Fig. 1). The parietal layer by further divisions gives rise to three layers of cells, of which the outermost forms the endothecium with the fibrillar thickenings (Fig. 4), and the innermost becomes the tapetum while the middle layer degenerates. The sporogenous layer after undergoing four to five divisions forms a mass of microsporocytes (Fig. 2). The microsporocytes become rounded and after meiosis give rise to microspore tetrads which show tetrahedral, isobilateral and decussate arrangements; of these the tetrahedral condition is most common. The tapetum is uninucleate to start with

but becomes multinucleate during later stages (Fig. 3). The microspores are triporate, and possess a thick and smooth exine (Fig. 5). Dehiscence occurs at the junction of the pollen sacs where the epidermal cells are smaller and the endothecium at this region lacks fibrillar thickenings. The pollen grains are shed at two-celled stage. Some of the pollen grains are shed at three-celled stage (Fig. 6).



FIGS. 1-12. Figs. 1-6. *Microsporogenesis and the male gametophyte*. Fig. 1. Archesporium dividing to form the primary parietal layer and the primary sporogenous layer, $\times 388$. Fig. 2. Part of anther showing anther wall and sporogenous cells, $\times 388$. Fig. 3. Multinucleate tapetal cells and microsporocytes, $\times 388$. Fig. 4. Fibrillar endothecium and degenerating tapetum, $\times 388$. Fig. 5. Microspore, $\times 388$. Fig. 6. 3 celled pollen grain, $\times 388$. Figs. 7-12. *Megasporogenesis and female gametophyte*. Fig. 7. Single megasporocyte, $\times 388$. Fig. 8. Multiple archesporium, $\times 290$. Fig. 9. Dyads dividing to form tetrads, $\times 290$. Fig. 10. Functional megaspore under division, $\times 290$. Fig. 11. 2-Nucleate embryo-sac, $\times 290$. Fig. 12. 8-Nucleate embryo-sac, $\times 96$. (b.n.c. = binucleate cells; i.t. = integumentary tapetum).

The ovary is superior, bicarpellary, bilocular and syncarpous in young stage, but later becomes four-loculed due to the development of a false septum. The ovules are orthotropous, unitegmina and tenuinucellar. A single hypodermal archesporial cell usually differentiates and directly functions as the megasporocyte (Fig. 7). A multiple archesporium is frequently seen, but even though all the cells may become the megasporocytes only one of them develops into an embryo sac and the others degenerate (Fig. 8). The nucellar epidermis undergoes a periclinal division and forms a parietal layer (Fig. 7). The megasporocyte undergoes the usual meiotic divisions and gives rise to a linear tetrad of megaspores (Fig. 9), of which the chalazal megaspore develops into a monosporic, Polygonum Type of embryo sac (Figs. 10-12). The scanty nucellus is used up and an integumentary tapetum is differentiated (Figs. 10-12). Certain enlarged binucleate cells in the chalazal region also help in the nutrition of the female gametophyte (Figs. 8 and 9).

I am highly thankful to Dr. M. Nagaraj, Professor of Botany, Central College, Bangalore, for his guidance. Thanks are also due to Sri. T. Thathachar for his kind suggestions and encouragement.

TASNEEM FATHIMA.

Central College,
Bangalore, September 16, 1965.

1. Svensson, H. G., *Zur Embryologie der Hydrophyllaceen, Boraginaceen und Heliotropiaceen*, Uppsala Arskrift, 1925, 2.

EMBRYOLOGY OF PITTOSPORACEAE

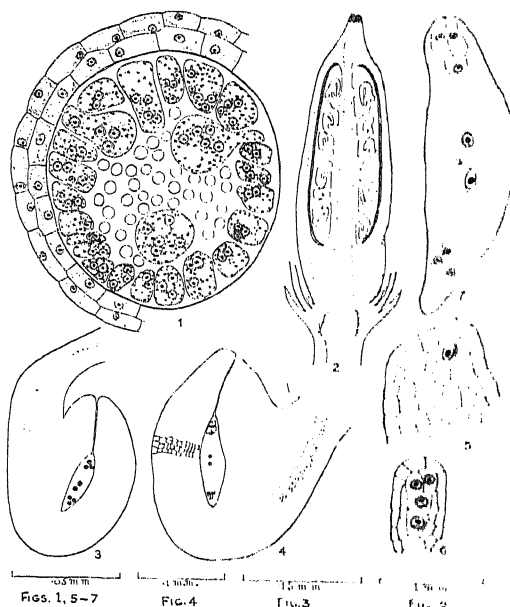
EARLY work on the embryology of Pittosporaceae was reviewed by Schnarf (1931). Subsequently, Mauritzon (1939) investigated the embryology of some species. A perusal of the earlier literature reveals several gaps and hence the present study which deals with the embryology of four taxa, viz., *Pittosporum floribundum* Wight and Arn., *Hymenosporum flavum* (Hook) FvM., *Marianthus procumbens* Benth. and *Bursaria spinosa* Cav.

The primary archesporium in the anther, differentiated at the time when the anther primordium becomes four-lobed, consists of two hypodermal rows of cells. These cut off a primary parietal layer, the cells of which undergo repeated periclinal and anticlinal divisions and build up the anther wall of 4-5 layers. The hypodermal wall layer develops into the endothecium and the innermost functions as the tapetum of the secretory type. The middle

layers become crushed during the development of the anther. The tapetal cells in *Pittosporum floribundum* and *Hymenosporum flavum* become binucleate by the time the pollen mother cells begin to undergo meiosis.

In *Marianthus procumbens* the tapetal cells become multinucleate. Nuclear divisions are followed by nuclear fusions. The polyploid nuclei show varying number of nucleoli.

In *Bursaria spinosa* the tapetal cells become much enlarged. Some of them become vesicular and project into the anther loculus (Fig. 1). Some



FIGS. 1-7. Fig. 1. *Bursaria spinosa*. Figs. 2-3. *Pittosporum floribundum*. Figs. 4, 6. *Marianthus procumbens*. Figs. 5, 7. *Hymenosporum flavum*. Fig. 1. T.S. anther lobe showing the multinucleate, hypertrophied tapetal cells. Middle layer crushed. Fig. 2. L.S. ovary showing the orientation of ovules. Figs. 3-4. L.S. ovule at the embryo-sac stage. Fig. 5. L.S. ovule showing archesporium. Fig. 6. T-shaped megaspore tetrad. Fig. 7. Young eight-nucleate embryo sac.

of them become liberated into it (Fig. 1). The vesicular tapetal cells show vacuolate cytoplasm and 2-5 nuclei (Fig. 1). The tapetal cells remaining at the periphery also become coenocytic (Fig. 1). By the time the pollen grains become mature, the tapetal cells at the periphery and those liberated into the anther loculus become absorbed.

Reduction divisions in the pollen mother cells are of the simultaneous type. Cytokinesis takes place by furrowing. While tetrahedral pollen tetrads are common, decussate arrangement was also noticed. Pollen grains are 3-celled at the shedding stage.

The ovule is tenuinucellar, unitegminal and hemianatropous (Figs. 2-4). In *Pittosporum floribundum* and *Bursaria spinosa* the raphe is dorsal (Fig. 2). In the former, the micropyles of the ovules in the lower half of the ovary face upwards while the ovules in the upper half show downwardly pointing micropyles (Fig. 2); in the latter the micropyles of all the ovules face upwards. In *Hymenosporem flavum* and *Marianthus procumbens* the ovules are horizontally placed and best median sections are obtained in transverse sections of the ovary.

The female archesporium is single-celled (Fig. 5). However, a multicellular archesporium was also observed in *Hymenosporem flavum*. The archesporial cell directly functions as the megaspore mother cell without cutting off a primary parietal cell. The megaspores show linear or 'T'-shaped arrangement (Fig. 6). The octonucleate embryo-sac develops according to the Polygonum type (Fig. 7) and shows the usual organization. The antipodals are ephemeral and the polar nuclei fuse before fertilization.

Our sincere thanks are due to Prof. M. R. Suxena for his interest and encouragement. We wish to express our deep sense of gratitude to Dr. H. J. Eichler and Mr. R. H. Kuchel for the materials of *Hymenosporem flavum* and *Bursaria spinosa*, and to Dr. W. M. Curtis and Mr. Bir Bahadur for the materials of *Marianthus procumbens* and *Pittosporum floribundum* respectively.

Department of Botany, R. SHEELA.
Osmania University, L. L. NARAYANA.
Hyderabad-7 (A.P.), June 22, 1965.

1. Mauritson, J., *Contributions to the Embryology of the Orders Rosales and Myrtales*, Lunds Univ. Årsskrift, N.F., 1939, Avd. 2, 35, Nr. 2.
2. Schnarf, K., *Vergleichende Embryologie der Angiospermen*, Berlin, 1931.

CYTOLOGICAL EFFECTS OF GAMMEXANE ON SOMATIC CHROMOSOMES OF URGINEA COROMANDELIANA HOOK. F.

GAMMEXANE is used as an insecticide and its polyploidizing and chromosome-breaking properties have been investigated on somatic chromosomes of *Allium cepa* (D'Amato, 1950; Sharma and Chaudhury, 1959; Sharma and Sarma, 1961). Kostoff (1948) and D'Amato (1949) pointed out that this chemical has similar widespread cytological effects on other plant materials. The present work relates

to the effects of gammexane on somatic chromosomes of *Urginea coromandeliana* Hook. f.

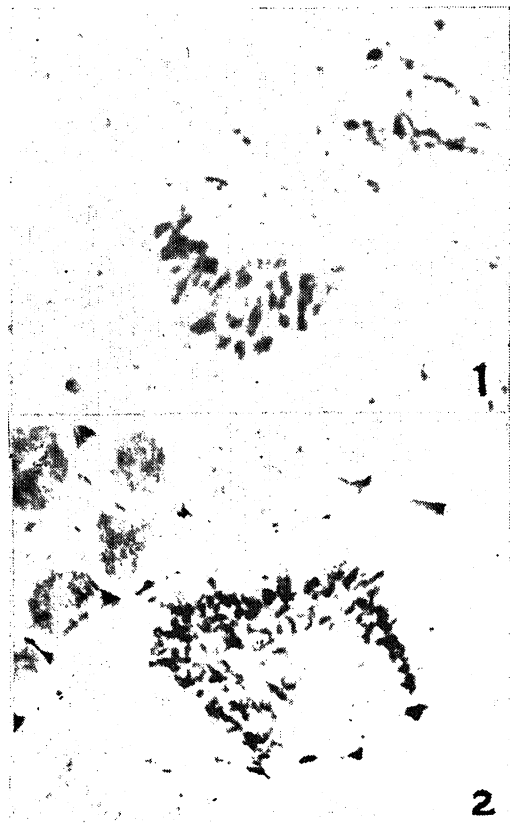
The solubility of gammexane is extremely low, being only 0.0004% approximately. Bulbs of *U. coromandeliana* were grown in saturated and in 0.5, 0.25 and 0.125 dilutions of saturated gammexane solution for one to seven days and then allowed to recover in Knop's solution. Aceto-orcein squash technique was followed without heating the materials which were kept for two hours in a mixture of 2% aceto-orcein and N HCl in the proportion 9:1. Squash preparations of untreated root-tips were also made as a check.

A saturated solution of gammexane was found to be lethal after a short period of treatment and phenomena like stickiness and clumped metaphases were observed. Among the concentrations, 0.5 and 0.25 dilutions of the saturated solution were most effective. In 0.25 dilution the time required to induce polyploidy was longer than in 0.5 dilution. In untreated root-tips 20 chromosomes were present and polyploid cells were not observed.

Colchicine mitosis was observed after five hours treatment in 0.5 dilution. With increase in time, polyploidy appeared and the frequency of polyploid cells increased as the treatment was continued. Polyploidy reached its maximum, with more than 120 chromosomes in some cells, after three days treatment. Further treatment inhibited cell division completely and all the cells were in resting condition. Diploid cells were found along with polyploid cells (Fig. 1) and the former were smaller in size than the latter. Among other irregularities chromatid bridges, peripheral arrangement of chromosomes and full contraction of metaphase chromosomes were observed. Rarely, reductional groupings were noticed even during treatment resulting in multinucleate cells. But no chromosome breakages were observed during period of treatment.

When the treated bulbs were allowed to recover in Knop's solution, reductional groupings were found, their frequency being higher than during the period of treatment. In most polyploid metaphases one to many unoriented chromosomes were observed which later formed micronuclei. Even after prolonged period of recovery in Knop's solution it was seen that the nucleus in some polyploid cells continued to divide, thus producing a higher number of chromosomes (Fig. 2). Treated materials continued to grow in Knop's solution for a period of fifteen days. Then cell division ceased and fresh lateral roots were produced with the normal diploid number of chromosomes.

Thanks are due to Dr. R. P. Patil for going through the manuscript and Shri C. C. Mukherjee for the photomicrographs.



FIGS. 1-2. Photomicrographs of *Urginea coromandeliana* Hook. Fig. 1. Metaphase in a polyploid and a diploid cell lying side by side. Fig. 2. A high polyploid cell at metaphase.

Central Botanical Lab., NITYANANDA DATTA.
76, Acharyya Jagadish Bose Road,
Calcutta-14, July 9, 1965.

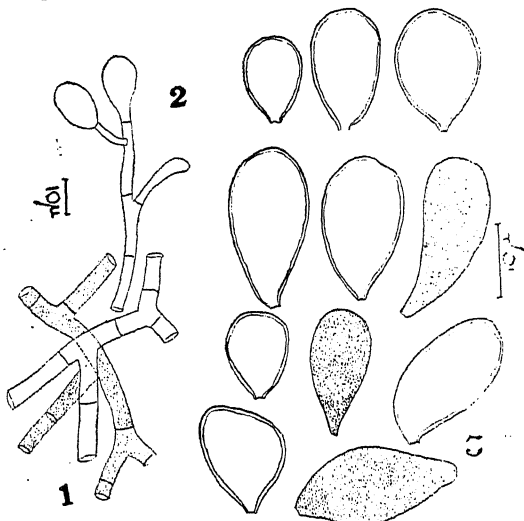
1. D'Amato, F., *Caryologia*, 1949, 1, 209.
2. —, *Ibid.*, 1950, 2, 361.
3. Kostoff, D., *Nature*, 1948, 162, 845.
4. Sharma, A. K. and Chaudhury, Mandira, *Curr. Sci.*, 1959, 28, 498.
5. — and Sarma, Mandira, *Nucleus*, 1961, 4, 157.

A NOTE ON THE OCCURRENCE OF *ALLESCHERIELLA CROCEA* (MONTAGNE) HUGHES, IN THE COFFEE ESTATES OF MYSORE

DURING the course of my investigations on the so-called new malady of *arabica* coffee in Mysore, I have very often collected a monilia-ceous fungus on decaying stumps of old shade trees killed by tree poisons. The fungus, which

has a very intriguing appearance in the fresh state, was first mistaken by me for some *Badhamoid myxomycete*. The disintegrating spore mass on the surface of the pustules appears like the decomposing peridium and the hyaline conidiophores within the fructification present the appearance of tubular capillitium of some *Physarales*. The collection was later on identified as *Allescheriella crocea*, a very common tropical fungus, which has not been recorded from India before.

Allescheriella crocea, it seems, was described under different names before, viz., *Mucor croceus* Mont., *Gymnosporium croceum* (Mont.) Berk. et Curt., *Chromosporium croceum* (Mont.) Sacc., *Gymnosporium fulvum* (Berk. et Curt.) Sacc., *Coniosporium fulvum* (Berk. et Curt.) Pound and Clements, *Rhinotrichum fulvum* Berk. et Curt. apud Berk., *Hyphoderma zeylanica* Petch., *Allescheriella uredinoides* P. Henn. The confusing systematic position of this imperfect fungus has been clarified by Hughes.¹



FIGS. 1-3. *Allescheriella crocea* (Montagne) Hughes. Fig. 1. Substrate mycelium. Fig. 2. Conidiophores and Conidia. Fig. 3. Conidia.

The young pustules are creamy white to begin with, then they turn ivory yellow with ochre tops with the formation of conidia. The fructifications are finally ferruginous when the conidia are mature. The repent, substrate mycelium, is a tangle of much branched hyphae measuring up to 8 μ wide. The mycelium is at first hyaline, later on becomes pale rusty brown. Conidiophores arise irregularly from the basal hyphae; they are hyaline, simple or branched, septate and produce conidia at the tops as blown-out ends. The conidia are of diverse shapes,

they are spherical, sub-spherical, ovoid or obovoid, flask-shaped pyriform. When mature the conidial wall is thick, two-layered, smooth. 12 to 25 by 12 to 20 μ . The detached spores have a prominent hilum at the base.

The fungus was collected on decaying stumps of *Ficus glomerata* Roxb. Lingapur Coffee Estate and on an unidentified tree stump in Biccode Estate in Hassan District.

I am grateful to Dr. M. B. Ellis of the Commonwealth Mycological Institute and Prof. Dr. G. W. Martin of the Iowa State University, U.S.A., for their help in identifying this fungus. My thanks are to the Divisional Manager, Fertiliser and Pesticides Division, Rallis India Limited, for permission to publish this note.

Rallis India Limited, V. AGNIHOTHRUDU.
P.O. Box No. 68,
Bangalore-1, August 2, 1965.

L. Hughes, S. J., *Mycological Papers*. No. 41, 1951, p. 17.

SEED VIABILITY TEST WITH 2, 3, 5. TETRAZOLIUM BROMIDE

THE use of tetrazolium test as a rapid method for estimating viability of seed and disclosing seed weaknesses has gained considerable importance in the seed industry. The principle of the viability test is that the colourless solution of this chemical is reduced to insoluble red triphenyl farmazan in the presence of respiratory (dehydrogenase) enzyme systems of viable tissue.

The present study was undertaken to obtain correlation between standard germination test and tetrazolium test.

Ten seed samples each of wheat and maize were germinated according to recommended methods for germination testing and also by tetrazolium method. In the latter case, two hundred seeds of each sample were precondi-

tioned (placed in moist paper at 30° C. overnight) and then sectioned longitudinally and medially through the embryo with a single edge razor blade. One half of each seed was then placed in 0.5% solution of tetrazolium bromide and kept in the dark (as the solution is sensitive to light) for two hours and evaluation of viability was made on the basis of staining of the embryo tissue.

The percentage of viable seeds obtained by both the methods is presented in Table I. It is

TABLE I

No. of Samples	Wheat		Maize	
	TT%	GT%	TT%	GT%
1	85	84	70	61
2	75	70	94	95
3	60	57	72	75
4	95	94	70	73
5	50	45	92	93
6	85	83	88	87
7	90	89	97	96
8	60	59	75	73
9	98	95	80	77
10	88	84	97	98

seen that the similarity between the percentage of germination and percentage of normally stained seeds is very close and the correlation found is $r = 0.99$.

This preliminary study on seeds of wheat and maize suggests the possibility of using tetrazolium method for determining seed viability quickly. For situations where the results are immediately required this method may be used as a complementary method.

Division of Botany,
Indian Agricultural

Research Institute,
New Delhi, August 31, 1965.

AMIR SINGH.
VIMAL MEHDI.

1. *International Rules for Seed Testing*, 1964.
2. *Flemion, Florence and Harriet Poole, Seed Viability Tests with 2, 3, 5, Triphenyl Tetrazolium Chloride*, Boyce Thompson Inst., 1948, 15 (4), 243.

REVIEWS AND NOTICES OF BOOKS

Generalized Functions, Vol. 4: Applications of Harmonic Analysis. By I. M. Gel'fand and N. Ya. Vilenkin. Translated by Amiel Feinstein. (Academic Press, New York and London), 1964. Pp. xiv + 384. Price \$ 11.50.

This collection of monographs is concerned with the theory of distributions of L. Schwartz. Few of these topics have been discussed to any extent outside of journals. Generally self-contained, this graduate-level treatise covers recent developments in the theory of linear topological spaces and construction of harmonic analysis of generalized functions on various spaces of test functions.

The titles of the chapters contained in the volume are as follows: 1. The Kernel Theorem, Nuclear Spaces, Rigged Hilbert Space; 2. Positive and Positive-Definite Generalized Functions; 3. Generalized Random Processes; and 4. Measures in Linear Topological Spaces.

The volume should be of interest to mathematicians, mathematical physicists and researchers in these fields. C. V. R.

Absolute Stability of Regulator Systems. By Aizerman and Gantmacher. (Holden-Day, Inc., 728, Montgomery Street, San Francisco), 1964. Pp. 172. Price \$ 8.95.

The present volume gives a historical survey of the problem, a systematic presentation of the main results obtained in the theory of absolute stability, as well as the author's point of view on the present state of the problem. It deals in detail with the work of A. I. Lur'e, V. M. Popov, R. E. Kalman, V. A. Yakubovitch, V. A. Pliss, and numerous other well-known researchers in the field of stability theory.

In order to make this book accessible to as broad an audience as possible, the authors have taken care not to use matrix techniques which would otherwise be more appropriate in a book of this kind. However, readers who are familiar with matrix theory will be able to translate easily the various results given in this text into matrix terminology. Thus, although basically intended as a reference text for the serious researcher, this book may be used equally well as a text for beginning graduate-level courses on non-linear systems and circuits. C. V. R.

Local Analytic Geometry (Volume XIV of Pure and Applied Mathematics. Edited by P. A. Smith and S. Eilenberg). By Shreeram Shankar Abhyankar. (Academic Press, New York and London), 1964. Pp. xv + 484. Price \$ 18.00.

The subject in this volume is handled in seven chapters whose titles are the following: I. Elementary Theory in C^n ; II. Weierstrass Preparation Theorem; III. Review from Local Algebra; IV. Parameters in Power Series Rings; V. Analytic Sets; VI. Language of Sheaves; and VII. Analytic Spaces. The number of articles given under each chapter is nine, seven, six, six, eleven, three and four respectively.

C. V. R.

Numerical Methods and Computers. By Prof. Shan S. Kuo. (Addison-Wesley Publishing Company, Inc., Reading, Massachusetts, U.S.A. and 10-15, Chitty St., London W. 1), 1965. Pp. x + 341. Price \$ 7.75.

This book is designed to serve as a text for courses given to engineering students and students of the pure and applied sciences as well as the quantitative social sciences. Its purpose is to acquaint these students with the methods of modern computation used in solving problems with the aid of high-speed computers. The development is essentially concerned with achieving two objectives: providing the necessary fundamental knowledge of the computer-oriented numerical methods for basic problems in algebra and analysis and acquainting the student with the digital computer. The text assumes a knowledge of calculus and, preferably, differential equations, and contains sufficient material for a one-semester course. The emphasis on the flow chart and a tested FORTRAN program for each numerical method provide the student with a real insight into techniques and guide the scientist and engineer to the solution of advanced problems.

C. V. R.

Development of Concepts of Physics. By Prof. Arnold B. Arons. (Addison-Wesley Publishing Company, Inc., Reading, Massachusetts, U.S.A. and 10-15, Chitty St., London W. 1), 1965. Pp. xviii + 972. Price \$ 11.25.

Intended for introductory courses, this text presents general physics from the 17th century

rationalization of mechanics to the first theory of atomic structure. The treatment is characterized by an emphasis on the development of concepts and lines of reasoning, which, when combined with sequentially structured questions, places physics in a meaningful perspective. Thus, the reader is led to recognize the role of idealizations and approximations, and to interpret the significance and limitations of various concepts and theories. Similarly, the reader is encouraged to look at problems from a more fundamental and less static point of view.

Throughout the text, historical and philosophical aspects of scientific thought are stressed. In fact, a good deal of the material is presented historically in order to illustrate the impact of scientific discovery on man's outlook toward the universe, how various important concepts were developed and subsequently modified, and why it is that scientific knowledge is provisional rather than final.

C. V. R.

Symmetries in Elementary Particle Physics—

1964. *International School of Physics "Ettore Majorana," a CERN-MPI-NATO Advanced Study Institute.* Edited by A. Zichichi. (Academic Press, New York and London), 1965. Pp. xii + 429. Price: Paperbound \$ 7.95; Clothbound \$ 12.00.

During two weeks in August-September 1964, 120 physicists from twenty-eight countries met in ERICE to attend the second course of the International School of Physics "Ettore Majorana", the proceedings of which are contained in this book.

The opening speech was delivered by G. Bernardini on "La fisica ed il progressor del pensiero scientifico attraverso i secoli". The programme included lectures, seminars and discussions. The lectures were delivered by the following persons: P. Kabir on Symmetry Principles in Particle Physics; S. M. Berman: Elements of SU_3 ; R. P. Feynman: Consequences of SU_3 Symmetry in Weak Interactions; R. Gatto: Vector and Axial Currents under First-Order Symmetry Breaking; G. Zweig: Fractionally Charged Particles and SU_6 ; P. Tarjanne: SU_4 ; L. C. Biedenharn: Some Properties of the SU_n Representation; N. Cabibbo: Possible Consequences of the $K_s^0 \rightarrow \pi + \pi^-$ Decay. The following were the speakers under the second section Seminars: J. Ashkin: Methods for Assigning Spin and Parity to Baryon Resonances; G. Bernardini: General Review of Neutrino Physics; M. M.

Block: Future Experiments in Neutrino Physics; G. Conforto: Measurement of the Angular Correlation of Electrons Relative to a Spin in $\Lambda^0 - \beta$ Decay; B. A. Sherwood: Momentum Spectrum of Positrons from Muon Decay. The discussions were led by R. P. Feynman and the closing lecture was also delivered by R. P. Feynman on Present Status of Strong Electromagnetic and Weak Interactions.

C. V. R.

Interpretation of Organic Spectra. By D. W. Mathieson. (Academic Press, New York and London), 1965. Pp. ix + 179. Price 42 sh.

The art of interpreting spectra in terms of structural formulæ requires a two-way approach. Firstly, a sound knowledge of where the various functional groupings and molecular structures show maximum absorption. Discussions of group frequencies in the infra-red, or of the resonances of protons in nuclear magnetic resonance or of the mode of fragmentation in the electron beam, all find appropriate texts in their various forms these cater for the first approach. The second and complementary requirement, however, is familiarity with actual spectra and adequate practice in interpreting them.

Interpretation of Organic Spectra is devoted to infra-red, N.M.R. and mass spectrometry, and within each section about ten spectra are fully discussed from their own particular viewpoints. In practice, of course, no one type of spectroscopy is used in isolation or, for that matter, without whatever orthodox chemical information can be supplied. For pedagogic reasons, however, each spectrum is considered alone in the hope that the strength as well as the weakness of each type of spectroscopy might become plain.

C. V. R.

The Alkaloids (Vol. 8): *The Indole Alkaloids.*

Edited by R. H. F. Manske. (Academic Press, New York and London), 1965. Pp. xv + 861. Price \$ 32.00.

Volume 8 of this well-known series contains twenty-two chapters. Cross-references and references to previous volumes are designed to expedite exhaustive study of a particular subject. Literature references are listed in the bibliography in the order in which they appear in each chapter. The entries in the subject index are limited to the important topics for each substance or group; substances mentioned only incidentally are not included.

The titles of the chapters and their respective authors contained in this volume are as follows;

ment, by A. Calverley; 13. Oxygen in High-Purity Iron, by R. Sifferlen and R. Collongues. C. V. R.

Industrial Waste Water Control. Edited by C. Fred Gurnham. (Volume 2 of *Chemical Technology*, Edited by R. F. Baddour.) (Academic Press Inc., 111 Fifth Avenue, New York), 1965. Pp. 476. Price \$16.00.

Pollution of natural waters is a health hazard. An inevitable result of modern civilization it is a matter of great public concern. Industry generally receives the major share of blame for stream pollution. It must however be said that most leaders of industry have accepted the responsibility of controlling the waste water discharges from their plants to minimize pollution. The problems connected with control of effluents are different for individual industries, yet there are certain parameters common to all, the evaluation and solution of which require the co-operative efforts of not only the industrialists but also experts in different disciplines such as engineers, chemists, biologists, etc.

Editor C. Fred Gurnham of the present multiauthor publication is the author of "Principles of Industrial Waste Treatment" published in 1955, by Wiley, New York, which book received a warm reception and also created a demand for a companion volume of the present type wherein experts connected with industries themselves could speak out on their problems of waste water control. Gurnham has succeeded in getting the co-operation of 24 authors who have contributed an equal number of chapters in the production of this book. Each chapter describes the industry itself, characteristics of the industrial waste waters, methods of treatment and disposal, and significant trends. Although confined to industries in the United States, the book as a guide and reference work will be of great value to those in other countries as well who are directly concerned with problems of industrial waste water control.

A. S. G.

Optical Model of the Atomic Nucleus. By I. Ulehla, L. Gomolcak and Z. Pluhar. (Academic Press, New York and London), 1965. Pp. 147. Price \$7.75.

Theoretical explanations of nuclear reactions with incident particles are based on some suitable physical model of the nucleus. Bohr

originally conceived the idea that the nucleus absorbs the incident particle and, together with it, forms a certain unstable system or a compound nucleus, which later decays, no matter how it originated. Experiments, however, did not corroborate this conception, and it was later proposed that the nucleus acts not as a completely absorbing kind but only as partially absorbing, and this idea of something like a transparent nucleus has led to what is now known as the optical model of the nucleus. The optical model has yielded valuable information on nuclear phenomena, especially in the low energy range, and it promises to be of more utility than the 'rigid model' or the 'shell model' in explaining nuclear reactions.

The book under review, which is an English translation of the original Czechoslovak Academy of Science publication, gives a complete review of the subject and its developments with references to original papers. A. S. G.

Books Received

Advances in Research and Applications (Vol. 4)—*Methods in Computational Physics—Applications in Hydrodynamics.* Edited by B. Alder, S. Fernbach and M. Rotenberg. (Academic Press, Inc., New York), 1965. Pp. xi + 385. Price \$14.00.

Mathematics in Science and Engineering (Vol. 17)—*Mathematical Theory of Connecting Networks and Telephone Traffic.* By V. E. Benes. (Academic Press, Inc., New York), 1965. Pp. xiv + 319. Price \$12.00.

Metabolism of Steroid Hormone. By R. I. Dorfman and F. Ungar. (Academic Press, Inc., New York), 1965. Pp. viii + 716. Price \$32.00.

Advances in Heat Transfer (Vol. 2). Edited by J. P. Hartnet. (Academic Press, Inc., New York), 1965. Pp. xi + 465. Price \$16.00.

Behaviour of Nonhuman Primates: Modern Research Trends. Edited by A. M. Schrier, H. F. Harlow and F. Stollnitz. Vol. 1: Pp. xv + 285 + 33. Price. \$9.00; Vol. 2: Pp. 286 + 595 + 33. Price \$9.50.

Applied Optics and Optical Engineering—A Comprehensive Treatise. Edited by R. Kingslake. (Academic Press, Inc., New York), 1965. Pp. xiii + 390. Price \$15.00.

The Alkaloids Chemistry and Physiology (Vol. 8)—*The Indole Alkaloids.* (Academic Press, Inc., New York), 1965. Pp. xv + 861. Price \$32.00.

THE NEW PHYSIOLOGY OF VISION

Chapter XXXV. The Faintest Observable Spectrum

SIR C. V. RAMAN

IT is a noteworthy characteristic of human vision that it can function usefully and enable us to perceive objects illuminated by light at enormously different levels of brightness. The magnitude of these differences is indicated by a comparison between the illumination provided by the light of the noon-day sun and the illumination received from the star-lit sky on a clear moonless night. Somewhere between these extremes is the illumination by the light of the full-moon shining in a clear sky. Astronomers rate the sun as a star of magnitude -26.8 and the full moon as a star of magnitude -12.0 . These figures indicate that moonlight is about half-a-million times weaker than sunlight. Star-light is, of course, much weaker than the light of the full-moon. It has been estimated that the integrated light from the stars received at ground level is weaker than sunlight by a factor of three hundred million or thereabouts.

The question naturally arises whether the apparatus of human vision is the same and functions in the same manner over the whole of this enormous range of intensity of the light perceived by it. This is an issue of great importance and interest. The term "apparatus of vision" is here intended to refer not to any particular area in the retinae of our eyes, as for example, the foveal region, but to the whole of the retina or at least to the part of it that can be observed to function in wide-angle vision. A method of investigating this problem which suggests itself is to study the spectrum of white light over the whole of this range of brightness making use of a technique which enables us to perceive simultaneously the functioning of the foveal region and of the outlying parts in the retina. The present investigation describes such a technique and sets out the surprising results which have emerged from the studies made with it.

The Technique of Study.—An extended linear source of light and a replica diffraction grating together make all the equipment that is needed for the purpose of the present study. The observer holds the diffraction grating close to his eye and views the line-source which may be at any convenient distance, the grating being held with its rulings parallel to the line-

source. The observer's field of view will then include the line-source as well as the diffraction spectra of various orders on either side of it. As the two diffraction spectra of the first order are usually much brighter than those of higher orders, the observer can view one or the other of those two spectra. Since the line-source may be of any convenient length, the spectrum under view will cover a great range of visual angles, both above and below the visual axis of the observer.

If the line-source is an elongated slit, it will be fully illuminated only if it is backed by an extended field of light. Hence, for such studies, a source of diffuse illumination covering the entire length of the slit is necessary. Since the aim of the investigation is to carry the study down to the lowest levels of illumination at which the spectrum can be perceived, it is necessary for the observer to be inside a completely darkened room and to remain there long enough to enable him to perceive the feeblest illumination. This may be for an hour or such longer period as may be found to be necessary. The only light which should find entry into the room is that passing through the slit under observation.

Two distinct choices are available for the light-sources to be studied. The first choice is that of the natural sources of diffuse light which are available over a great range of brightness, *viz.*, the sun-lit sky in daytime, the progressively altering illumination of the sky during the twilight period, the sky illuminated by the light of the moon in its various phases, and finally the star-lit sky on a clear moonless night.

The other choice is that of artificial sources of light. As we are concerned with the spectrum of white light, we naturally choose a source which is inherently of high luminosity. The question here arises of a procedure by which the light can be reduced to the lowest levels of luminosity, but without any change in its spectral character. The procedure which has been devised and which enables this aim to be realised is to allow a beam of light from a tungsten-filament lamp run at a high temperature to be diffused by a milk-white plastic screen, three such screens in succession being employed. The screens have polished surfaces

which reflect a part of the incident light. But they are so placed with respect to each other that these reflections are not made use of, but only the light that diffused in directions other than that of regular reflection by the surface of the screen. The light is much enfeebled in this manner but without any change in its spectral character. By placing the three screens which operate by such diffusion at suitable distances from each other, the brightness of the light that is received and diffused by the third screen and thereafter passes through the slit under view by the observer is enormously reduced. It should be mentioned here that the luminosity of the spectra as seen by the observer is determined by the width of the slit and its distance from the observer. It can be altered through a great range of values by the observer approaching towards the slit or moving away from it.

Observations during Twilight.—To study the spectrum of skylight during the twilight period, the observer places himself at a distance of about three metres from one of the windows of a room, all of which are covered by wooden shutters, but of which one can be opened a little so as to admit light from the sky through a narrow vertical slit about 150 centimetres in length. The opening of the slit can be varied, about a centimetre being the most suitable, though narrower slits can also be made use of. The resolution and dispersion provided by the diffraction grating in these circumstances is such that a great many of the Fraunhofer lines in the solar spectrum are clearly seen when the sun-lit sky is viewed through the slit by the observer with the grating held in front of his eye. To serve as a standard of comparison, a white diffusing screen of sufficient size is set up at a suitable distance so that it can be viewed through the slit. If the screen is lit up by direct sunlight, the solar spectrum seen by the observer exhibits the features characteristic of fairly high levels of brightness. The greatest luminosity is then in the yellow sector of the spectrum and the blue sector shows all its three different colours, viz., blue, indigo and violet in the order of diminishing wavelength.

In the latitude of Bangalore, the duration of twilight, in other words, the interval between the setting of the sun and the emergence of the fainter stars from the luminous background due to scattered sunlight is about an hour. During this period, great changes manifest themselves in the brightness of the part of the sky under observation. At the same time, however, the eyes of the observer seated in

the dark room become enormously more sensitive to faint light. As a result, the slit continues to appear to be nearly as bright as before. But the spectrum of the light emerging through the slit is observed to alter in a remarkable fashion.

Four noteworthy changes may be noted in the appearance of the spectrum in the first half-hour of twilight during which the sky and the landscape illuminated by it both remain fairly bright. One of these changes is in the appearance of the blue sector of the spectrum. The bright blue which precedes the indigo and the violet in the spectrum disappears and is replaced by the darker indigo colour and this in its turn disappears, the "blue sector" then appearing of a violet colour throughout. A little later, the violet colour also fades away, but the "blue sector" continues to be distinguishable from the adjoining green sector by reason of its lack of colour and its much smaller luminosity.

A second noticeable change is in the location of the most luminous part of the spectrum. This exhibits a very definite shift, moving from the yellow sector into the green sector, in other words, from about $580\text{ m}\mu$ to about $550\text{ m}\mu$. But the green colour of the spectrum in the wavelength range between $500\text{ m}\mu$ to $560\text{ m}\mu$ remains conspicuous. Indeed it appears distinctly more saturated than when the spectrum as a whole is highly luminous.

The third and indeed most striking change in the character of the spectrum is the progressive contraction and final disappearance of the red sector of the spectrum, in other words, of the part of the spectrum included in the wavelength range between $700\text{ m}\mu$ and $600\text{ m}\mu$. The longer wavelengths in this region are the first to become too feeble to be observed, despite the greatly increased sensitivity of the eye to dim light. When the visible end of the spectrum is at about $650\text{ m}\mu$, a distinct change is noticeable in the colour of the region between $650\text{ m}\mu$ and $600\text{ m}\mu$. It then assumes a deeper red hue. Finally, the spectrum in this region becomes too weak to be observed and disappears from sight. This disappearance occurs long before the twilight illumination of the sky itself becomes unobservable, and while the landscape outside is still clearly visible in all its details.

The fourth and last change in the character of the spectrum is the weakening and disappearance of the yellow sector of the spectrum, in other words of the wavelength range between $560\text{ m}\mu$ and $600\text{ m}\mu$. The disappearance of the yellow closely follows that of the red sector.

But when the red and yellow sectors are no longer observable, the green sector remains conspicuous. Thus, the spectrum of skylight in the latter part of the twilight period consists principally of the green sector in the wavelength range between $560\text{ m}\mu$ and $500\text{ m}\mu$, the maximum of luminosity being at about $540\text{ m}\mu$. This is accompanied by a weak extension towards shorter wavelengths, representing the residue of the blue sector which remains visible at this stage.

It should be emphasised that the foregoing features are not in any way different in the different areas of the retina in which the spectrum is visibly manifested.

The Spectrum of the Star-Lit Sky.—The disappearance of twilight from the sky is followed by a further fall in the intensity of the spectrum which nevertheless continues to be visible. All trace of colour having vanished, a method had to be devised to make it possible to ascertain the region of wavelengths in which the spectrum continues to be visible. This is accomplished by the use of a comparison spectrum of which the brightness is not so great as to disturb the sensitivity of the observer's vision but nevertheless allows spectral lines of known wavelength to be discernible. A white diffusing screen is placed below the level of the part of the sky under observation so that it can be seen through the same slit. This screen is illuminated by a beam of light from a distant mercury lamp or sodium lamp reflected by a system of mirrors. The characteristic lines of the spectrum of mercury or of sodium are then seen below and in a line with the continuous spectrum of the sky. The comparison spectrum could be switched off except when it is actually needed for locating the position and extension of the continuous spectrum which it adjoins.

From such observations, it becomes evident that the blue sector of the spectrum is not present in the spectrum of the star-lit sky. The limits of the part of the spectrum which continues to be visible can be determined by reference to the positions of the discrete lines of mercury and of sodium appearing below it. The yellow sodium doublet $\lambda 5890\text{--}5896$ is found to lie well outside the limits of the observable spectrum. Likewise, the violet line $\lambda 4358$ of the mercury arc lies outside those limits. On the other hand, the green $\lambda 5461$ mercury line lies well within the region of the visible continuous spectrum. The yellow doublet $\lambda 5770\text{--}5790$ of mercury appears just outside the long wavelength limit of the sky-spectrum, while the

weak $\lambda 4916$ of mercury appears close to its short-wave limit. What is actually seen of the spectrum is thus confined to the wavelength range between $560\text{ m}\mu$ and $500\text{ m}\mu$, the brightest part being at about $530\text{ m}\mu$. These features are exhibited by the entire length of the spectrum covering the retina, irrespective of the particular part of it towards which the observer directs his vision.

The observations of the star-lit sky were made at various hours of the night when the sky was quite clear and free from haze or cloud, and the disturbing effects arising from the city-illumination were therefore at a minimum. The sky to the north of the Institute was made use of, since it was much better than the sky to the south in its freedom from such disturbance. No significant differences in the characters of the spectra could be noticed depending on the part of the sky under observation or on the time at which the observations were made.

Observations with Artificial Light-Sources.—The technique employed for such observations has already been described. It proved highly successful by reason of the fact that two dark rooms were available which were connected by a covered passage with two right-angle bends in it. It was possible, therefore, to place a brilliant source of light in one room without any light finding its way into the other room through the passage. The light diffused by a brilliantly illuminated screen placed in one room and then successively by two other diffusing screens placed at the two corners of the passage fell upon a slit placed near the entrance to the second room. This slit could be viewed by the observer through his diffraction grating.

The slit employed was two millimetres wide and thirty centimetres long, and the observer could vary his distance from it to any extent desired. The observed luminosity of the spectrum could thus be varied over a great range of values. A further means of controlling the luminosity of the observed spectrum was by altering the illuminated area of the first diffusing screen. This area could be reduced from a circle of 40 centimetres diameter down to a circle of 6 centimetres diameter, thus allowing a reduction of luminosity by a factor of about 50.

The changes in the character of the observed spectra resulting from each step-down in the level of illumination could be made evident by replacing each diffusing screen by a reflecting mirror, thereby resulting in a great increase

in the brightness of the illumination reaching the slit. The determination of the wavelength range in which the spectrum continues to be observable at the lower levels of illumination is effected with the aid of the discrete lines in comparison spectra of low intensity viewed through the same slit for a brief period of time sufficient to enable the observer to fix their positions.

Results of the Investigation.—The results of the study made with artificial light sources are in full agreement with those described above using skylight at various levels of illumination. We may now sum up the conclusions reached. The spectrum of white light consists of four sectors, the wavelength ranges in which they appear being respectively from $400\text{ m}\mu$ to $500\text{ m}\mu$ for the blue sector, from $500\text{ m}\mu$ to $560\text{ m}\mu$ for the green sector, from $560\text{ m}\mu$ to $600\text{ m}\mu$ for the yellow sector and from $600\text{ m}\mu$ to $700\text{ m}\mu$ for the red sector. At high levels of illumination, the yellow sector is the most conspicuous, the red, green and blue sectors following it in that order. When the level of illumination is lowered sufficiently, the red sector is the first to pass out of sight, and is then followed by the yellow sector. At the lowest levels of illumination, the blue sector also disappears till finally we are left only with the green sector covering the wavelength range from $500\text{ m}\mu$ to $560\text{ m}\mu$. It then exhibits no observable colour, but the maximum of brightness is at about $530\text{ m}\mu$. Thus, it is this restricted range of the spectrum which actually enables us to perceive and recognise the most dimly illuminated objects. This statement is valid alike for the fovea and

for the outlying regions of the retina, there being no noteworthy differences between them at such levels of illumination.

Some remarks are here called for regarding the so-called "visual purple" which has in the past been identified as the material present in the retina that enables dim light to be perceived. The absorption spectrum of "visual purple" has been studied by several investigators. It exhibits a maximum of absorption at $500\text{ m}\mu$, the absorption diminishing to smaller values both at higher and lower wavelengths. The absorption covers the entire range of wavelengths from $650\text{ m}\mu$ to $400\text{ m}\mu$, and should therefore be effective in the perception of all the sectors of the spectrum. The behaviour of "visual purple" thus inferred is wholly different from the characteristics of human vision at low levels of illumination established by the present investigation. It would seem, therefore, that the identification of the "visual purple" as the material which makes vision possible at such low levels is a misconceived idea.

One need not doubt that the "visual purple" is actually present in the living retina and that it subserves some physiological purpose. This purpose may be that of a protective material for preventing damage to the delicate structures of the retina by the incidence of strong light, especially in the region of shorter wavelengths. The photochemical decomposition of the material by strong light and its reconstitution in dim light may, in fact, be the means by which this protective action is brought into play.

MAGNETOHYDRODYNAMICS

THE volume under review* embodies the addresses delivered and the papers presented at a Seminar on the subject of magnetohydrodynamics sponsored by the University Grants Commission and held at Bangalore in May 1963. Of particular value and interest are the contributions to the Seminar by Dr. P. L. Bhatnagar by whom it was organised and directed. Besides an admirable general introduction to the subject, mathematical presentations of the following topics by him appear in the volume: The Equations of

Magnetohydrodynamics; Non-linear Waves; The Kinetic Equations of Plasma. These memoirs will be found to be very illuminating by those who desire to make a fuller study of the subject and enter this fascinating field of research.

The numerous other articles appearing in the volume are all by Indian authors and have been written by members of the staff at the centres of advanced study and research located at various places in the country, viz., Bangalore, Bombay, Madras, Delhi, Kanpur and Kharagpur.

The volume is well printed and is modestly priced. It is a notable contribution to the literature of science produced in the country.

* *Proceedings of the Summer Seminar in Magnetohydrodynamics*. Edited by Dr. P. L. Bhatnagar and published by the Department of Applied Mathematics, Indian Institute of Science, Bangalore-12, 1965. Pp. ix + 376. Price Rs. 12-50.

THE USE OF ANOMALOUS SCATTERING OF NEUTRONS IN THE SOLUTION OF CRYSTAL STRUCTURES CONTAINING LARGE MOLECULES*

S. RAMASESHAN

Department of Physics, Indian Institute of Technology, Madras-36

1. INTRODUCTION

THE effectiveness of anomalous dispersion methods for phase determination in X-ray crystallography has been established beyond question. The anomalous dispersion effects are much more pronounced in the case of neutron scattering than in X-ray scattering. This opens up immense possibilities of using anomalous neutron scattering for solving structures of very large molecules. The essential differences between X-ray and neutron scattering have been discussed in this paper and some novel ways in which the anomalous neutron scattering could be exploited for the solution of the phase problem, have been proposed.

2. ANOMALOUS SCATTERING OF X-RAYS

When the wavelength of the incident X-ray beam is close to an absorption edge λ_k of an atom, the atomic scattering factor may be expressed as

$$f = f_0 + \Delta f' + i \Delta f''$$

f_0 is the normal scattering factor for wavelengths far from the absorption edge, $\Delta f'$ is the real part and $\Delta f''$ the imaginary part of the dispersion corrections. The magnitudes of both these quantities are small compared to f_0 . The variation of $\Delta f'$ and $\Delta f''$ with wavelength is illustrated in Fig. 1.

Coster, Knol and Prins¹ established that this complex scattering factor leads to the violation of Friedel's law in non-centrosymmetric structures. Bijvoet and his collaborators² showed how this effect [$I(hkl) \neq I(\bar{h}\bar{k}\bar{l})$] can be used to determine the absolute configuration of crystals. They also pointed out the possibility of using this inequality for determining the phases of the reflections. The analytical expression relating the phases and the observed

intensities was given by Ramachandran and Raman.³

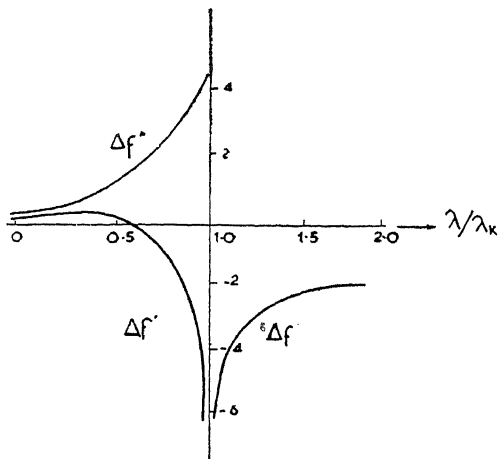


FIG. 1. Variation of $\Delta f'$ and $\Delta f''$ with wavelength in X-rays near an absorption edge.

Mark and Szillard,⁴ demonstrated that anomalous scattering of X-rays without phase change ($\Delta f'$ negative) is equivalent, in effect, to reducing the scattering power of the atom. Ramaseshan, Venkatesan and Mani⁵ showed that if a pair of wavelengths on either side of the absorption edge of one of the species of atoms in the structure are used, the situation is equivalent to collecting data using a single wavelength with two perfectly isomorphous structures. They showed in a simple case that all the techniques of isomorphous replacement methods could validly be adopted. It was also suggested by them that when $\lambda_1 < \lambda_k < \lambda_2$, $[F(hkl)]_{\lambda_1}$, $[F(\bar{h}\bar{k}\bar{l})]_{\lambda_1}$ and $[F(hkl)]_{\lambda_2}$ could in principle be combined to determine the phase of the hkl reflection. For a review on anomalous X-ray scattering see Ramaseshan.⁶

3. ANOMALOUS NEUTRON SCATTERING†

That neutrons also were scattered anomalously by some nuclides was shown by a series

* This work was done when the author was a Senior Visiting Fellow at the Chemical Crystallography Laboratory, Oxford, England, during 1964-65. The matter reported here formed a part of the special talks delivered by the author at the Meeting of the American Crystallographic Association held in Gatlinburg (Tenn.), U.S.A. on the 1st of July 1965 and at the Annual Meeting of the Indian Academy of Sciences held in Hyderabad, India, on 21st December 1965.

† The author is grateful to Dr. B. T. M. Willis, Metallurgy Division, A.E.R.E., Harwell, England, for bringing to his attention the pioneering work of Peterson and Smith.

of careful experiments by Peterson and Smith.⁷ They repeated the classical experiment of Coster, Knol and Prins with neutrons scattered by Cd^{113}S and demonstrated the violation of Friedel's law. They showed that the anomalous scattering length could be written as $b = b_0 + b' + ib''$ and by comparing the X-ray and neutron scattering data they found that b'' leads $(b_0 + b')$ in phase by $\pi/2$ exactly as in the case of X-rays. They pointed out that Li^6 , B^{10} and Cd^{113} which scattered thermal neutrons anomalously could be useful in determining the absolute configuration of crystals by neutron scattering. This was indeed borne out by Johnson, Gabe, Taylor and Rose⁸ who determined the absolute configuration of the Li-salt of the enzymatically formed α -mono-deutero glycolate using neutron diffraction. Peterson and Smith also suggested that the phase problem in neutron scattering could be solved by the methods suggested by Bijvoet in X-ray scattering.**

The scattering length for neutrons in the resonance region is given by the Breit-Wigner¹⁰ formula†

$$b = R + \frac{1}{2} \frac{g \omega \lambda_0 \Gamma_n (E - E_0)}{(E - E_0)^2 + \Gamma^2/4} + i \frac{1}{4} \frac{g \omega \lambda \Gamma_n \Gamma}{(E - E_0)^2 + \Gamma^2/4}$$

where g is the spin weighting factor, $\lambda_0 = \lambda_c/2\pi$, Γ_n is the neutron width, Γ the total width, E the energy of measurement, E_0 the resonant energy and R the weighted mean of the nuclear radius corresponding to potential scattering. Brockhouse,¹¹ who measured the scattering cross-sections for neutrons of different energy, found that, for most nuclides an one-level Breit-Wigner formula fitted the experimental data very well. Figure 2 gives the curves for b' and b'' for Cd^{113} as calculated from the measurements of scattering and absorption cross-sections made by Brockhouse. The essential features of these curves have been verified by Peterson and Smith by accurate measurements of intensities of $I(hkl)$ and $I(\bar{h}\bar{k}\bar{l})$ in Cd^{113}S for different wavelengths.

** Dr. David Dale now at Harwell has since December, 1962, been pursuing this suggestion of Peterson and Smith. He has been trying to apply to neutron scattering the method of phasing that the Oxford group (Dale, Hodgkin and Venkatesan) so successfully used in solving the structure of Factor V (1) α .

† According to the original Breit-Wigner formula the imaginary part is negative, indicating a phase lag of 90° w.r.t. the real part. However the positive sign is used (phase lead of 90°) in accordance with the experimental result of Peterson and Smith.⁷

This is indeed an achievement as the incident intensity near $\lambda = 0.68$ is itself quite low and the absorption in this region for Cd^{113} is extremely high.

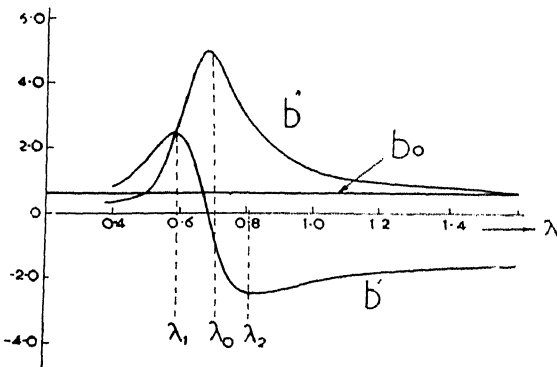


FIG. 2. Variation of b_0 , b' and b'' with wavelength near the absorption for Cd^{113} .

Comparing the dispersion correction curves for X-rays and neutrons one finds that $\Delta f'/f_0$ and $\Delta f''/f_0$ have a maximum value of about 0.15 (at $\sin \theta = 0$) and about 0.30 at $\sin \theta = 0.8$ while these ratios for neutrons are almost two orders of magnitude larger, (b'/b_0 5.0–7.0 and b''/b_0 10 to 12). Further the very forms of the dispersion curves in the two cases are completely different. The imaginary part b'' has a large positive value ($10 b_0$) at the resonance wavelength dropping to smaller positive values of the order of b_0 on either side. On the other hand the real part of the scattering factor b' reaches a maximum ($+5 b_0$) on the shorter wavelength side of the resonance wavelength, becomes zero at resonance and beyond this becomes negative, reaching a minimum ($-5 b_0$) on the longer wavelength side. Peterson and Smith have actually verified this negative scattering predicted by the Breit-Wigner formula. We shall in the next sections examine how these qualitative and quantitative differences between the X-ray and neutron anomalous dispersion could be used effectively for solving the phase problem.

4. THE CONCEPT OF THE "HEAVY ATOM" IN NEUTRON SCATTERING

Normally the neutron scattering lengths of most atoms are of the same order of magnitude. Hence there is nothing corresponding to the "heavy atom" in neutron diffraction. However if the structure contains an anomalous scatterer of neutrons in the asymmetric unit and if wavelengths for which $|b'|$ is large is used, the real part of the scattering factor would be 5

to 10 times the scattering factor of normal atoms. This is equivalent to having a heavy atom in the structure. Techniques used in X-ray diffraction such as the Patterson synthesis could therefore be used for locating these "heavy atoms".

(a) *The Patterson synthesis*: For the p th atom

$$b_p = [(b_0)_p + b_p'] + ib_p'' = B_p' + ib_p''.$$

It can easily be shown that

$$\begin{aligned} |F(hkl)|^2 = & \sum_p \sum_q (B_p' B_q' + b_p'' b_q'') \\ & \times \cos 2\pi [h(x_p - x_q) \\ & + k(y_p - y_q) + l(z_p - z_q)] \\ & + \sum_p \sum_q (B_p' b_q'' - B_q' b_p'') \\ & \times \sin 2\pi [h(x_p - x_q) \\ & + k(y_p - y_q) + l(z_p - z_q)]. \end{aligned}$$

Hence the Patterson synthesis

$$P(u, v, w) = \sum_0^\infty \sum_0^\infty \sum_0^\infty h \sum_l |F(hkl)|^2 \times \cos 2\pi(hu + kv + lw)$$

contains peaks of height $(B_p' B_q' + b_p'' b_q'')$ at $u = x_p - x_q$, $v = y_p - y_q$, $w = z_p - z_q$. It must be noted that in neutron scattering unlike in X-ray diffraction we have negative normal scatterers (particularly hydrogen). Thus the positive peaks in the Patterson correspond to interactions between like-scatterers while negative peaks to interaction between unlike-scatterers.

For normal scatterers(N):

$$|B_p'| = |(b_0)_p| > 0, b_p' = b_p'' = 0.$$

For anomalous scatterers(A):

$$|B_p'| = |(b_0)_p + b_p'| > 0, b_p' > 0.$$

Hence in the Patterson synthesis the following vectors will be present.

$$A_n \rightarrow A_m \text{ of height } (B_{An}' B_{Am}' + b_{An}'' b_{Am}'')$$

$$A_n \rightarrow N \text{ of height } (B_{An}' b_N)$$

and

$$N_n \rightarrow N_m \text{ of height } (b_{Nm} b_{Nn})$$

It is quite clear that the interactions between anomalous scatterers will dominate and so it would be possible to identify these peaks. In a specific example if a structure has one Cd atom and a large number of other atoms, the Cd-Cd peak would normally have a height of b_0^2 ($b_0 = 0.4 \times 10^{-12}$). However, if the structure contains Cd¹¹³ and a wavelength 0.825 Å is used then $b' = -6b_0$ and $b'' = +6b_0$. Thus $B_{Cd}' = (b_0 - 6b_0)$ and so the Cd-Cd peak will have a height of $25b_0^2 + 36b_0^2 = 61b_0^2$ while the

Cd-N and N-N interactions will have heights approximately $\mp 5b_0^2$ and b_0^2 respectively (assuming $|b_0| \simeq |b_N|$).

It is common experience in X-ray crystallography that the heavy atom-heavy atom interactions are swamped out by the heavy atom-light atom vectors if the number of light atoms is sufficiently large. Various techniques have been suggested to overcome this.¹² Neutron anomalous scattering provides an effective method for eliminating the heavy atom-light atom vectors rendering the identification of the heavy atom-heavy atom vectors easy.

If the intensity measurements are made at the wavelength at which $B_p' = (b_0)_p + b_p' = 0$. Then for $B_A' = 0$ and $b_A'' > 0$ and $B_N' > 0$ and $b_N'' = 0$.

Hence there will be no A-N vectors and only the A-A vectors (weight $121b_0^2$) and N-N vectors (weight b_0^2) will survive.

(b) *The Two-Wavelength Method*.—If the measurements are made at two wavelengths on either side of the resonance wavelength λ_0 , then it should be comparatively easy to determine the position of the anomalous scatterer. Let us for the sake of convenience choose two wavelengths λ_1 and λ_2 such that $B_{\lambda_1}' = -B_{\lambda_2}'$ and $b_{\lambda_1}'' \simeq b_{\lambda_2}''$. The Patterson syntheses with $|F(hkl)|_{\lambda_1}^2$ and $|F(hkl)|_{\lambda_2}^2$ as coefficients would be similar except that the weights A-N vectors would have changed signs (the A-A and N-N vectors would however all be identical). An addition-Patterson with coefficients $|F(hkl)|_{\lambda_1}^2 + |F(hkl)|_{\lambda_2}^2$ would therefore give only the A-A and N-N interactions while the A-N vectors would be suppressed. It must be noted that A-N vectors will not be suppressed completely if b_{λ_1}'' and b_{λ_2}'' are much different. A single set of measurements of intensities at λ_0 would be as effective as the measurements at two wavelengths, so far as the location of heavy atom is concerned. However the two-wavelength method has many advantages over the resonant wavelength method such as lower absorption, possibility of determining the phases of reflections uniquely, etc.

A subtraction Patterson with coefficients $|F(hkl)|_{\lambda_1}^2 - |F(hkl)|_{\lambda_2}^2$ would only give A-N vectors. Even if B_{λ_1}' is not exactly equal to $-B_{\lambda_2}'$ one could by algebraic manipulations of the data formulate syntheses which give essentially the above results.

PHASE DETERMINATION PROCEDURES

It is clear from the above discussion that one can use the heavy atom technique in neutron diffraction to determine the phases of reflections. In X-ray diffraction, the heavy atom method

is successful in phase determination even when the heavy atom ratio $[\Sigma f_H^2 / \Sigma (f_L^2 + f_H^2)]$ is as low as 0.10 (Vitamin B₁₂). One has only to redefine for anomalous neutron diffraction the heavy atom ratio as $\Sigma (B_A'^2 + b_A''^2) / \Sigma (b_N^2 + B_A'^2 + b_A''^2)$. This ratio is 0.10 even if the asymmetric unit contains only one Cd¹¹³ and 1,000 to 2,000 normal scatterers and thus the heavy-atom method may succeed. If Sm¹⁴⁹ or Gd¹⁵⁷ are used the proportion of the normal scattering atoms can be very much larger.

By measuring the intensity $I(hkl)$ and

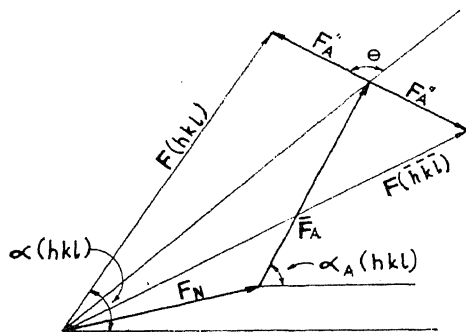


FIG. 3. The vector phase diagram for $F(hkl)$ and $F(\bar{h}\bar{k}\bar{l})$.

$I(\bar{h}\bar{k}\bar{l})$ one could get the phase angle (Fig. 3). $\sin [a(hkl) - a_A(hkl)]$

$$= \frac{|F(hkl)|^2 - |F(\bar{h}\bar{k}\bar{l})|^2}{4 \left[\frac{1}{2} (|F(hkl)|^2 + |F(\bar{h}\bar{k}\bar{l})|^2) - F_A'^2 \right] F_A''}$$

If the position of the anomalous scatterer is known then from the methods given above, $a(hkl)$ and F_A'' may be calculated from which $a(hkl)$, the phase of the reflection, could be computed. However, there would be a twofold ambiguity in the phase angle of each reflection. If the anomalous scatterers are not centro-symmetrically distributed, then a Fourier synthesis with both the phases should in principle give the structure. When $b'' \simeq b' \gg b_0$ one must be cautious in applying many of the methods used in X-ray crystallography where $\Delta f'' \simeq \Delta f' \ll f_0$.

Thus a convenient method to determine phases would be to (a) measure the intensities of the Friedel pairs for the two wavelengths λ_1 and λ_2 , (b) determine the position of anomalous scatterer by addition—Patterson or its equivalent, (c) calculate a_A from the known position of the anomalous scatterer, and (d) evaluate $a(hkl)$

using $|F(hkl)|_{\lambda_1}$, $|F(\bar{h}\bar{k}\bar{l})|_{\lambda_2}$ and $|F(hkl)|_{\lambda_1}$ in a Harker construction (Fig. 4).

The work of Prof. Dorothy Hodgkin and her collaborators [e.g., Factor VI(a), Vitamin B₁₂ mono acid] indicates that with one cobalt ($\Delta f''/f_0 \simeq 0.15$ for CuK_α) atom it is possible

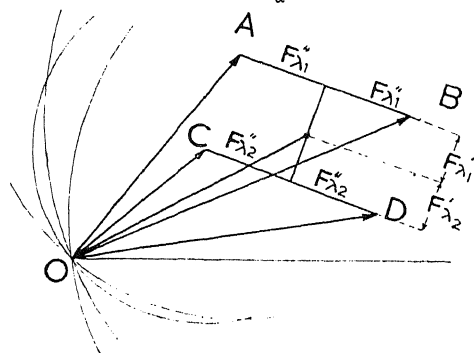


FIG. 4. Method of unique phasing in neutron diffraction. $OA = [F(hkl)]_{\lambda_1}$, $OB = [F(\bar{h}\bar{k}\bar{l})]_{\lambda_1}$, $OC = [F(hkl)]_{\lambda_2}$, and $OD = [F(\bar{h}\bar{k}\bar{l})]_{\lambda_2}$.

to solve structures containing about a hundred non-hydrogen light atoms. With the same space group P_2 it must be possible to phase reflections of a structure containing 10,000 atoms and one Cd¹¹³ per asymmetric unit. With Sm¹⁴⁹ and Gd¹⁵⁷, the number of light atoms could increase three- or fourfold.

THE CHOICE OF ANOMALOUS SCATTERER AND THE EXPERIMENTAL PROBLEMS

The absorption due to the anomalous scatterer would be inordinately large near the resonant frequency. However, overall absorption would be much smaller if a large number of light atoms are present. If one wishes to study smaller molecules one could reduce the proportion of the resonant-isotope by diluting it with normal isotope.

The measurement of accurate intensities in neutron scattering in such large structures is fraught with many difficulties. (a) There is a decrease in the intensity due to the large size of the unit cell. (b) The divergence of the incident beam has to be cut down, with a consequent decrease in incident intensity, to resolve the closely spaced reflections. (c) The background intensity due to incoherent scattering is expected to be large. Besides these, one has to grow large single crystals with the resonant-isotope introduced at proper sites.

There are four elements Eu¹⁵¹ ($\lambda_0 \simeq 0.6 \text{ \AA}$), Cd¹¹³ ($\lambda_0 \simeq 0.68 \text{ \AA}$), Sm¹⁴⁹ ($\lambda_0 \simeq 0.93$) and Gd¹⁵⁷ ($\lambda_0 \simeq 1.8 \text{ \AA}$) which show resonance in the thermal neutron range. Of these Sm¹⁴⁹ and Gd¹⁵⁷ would be perhaps most useful because

their resonance frequencies are close to the maximum of the thermal neutron spectrum of a normal nuclear pile. Further the increase in scattering due to increase in wavelength enhances the intensity of each reflection.

As the signal-to-noise ratio (due to incoherent scattering) in these crystals of large molecules is expected to be low, one has to explore the possibility of measuring the intensity of a large number of reflections simultaneously (like the Phillips-technique¹³). One must also think of extending such unconventional methods as spark-chamber techniques for the measurement of intensities to neutron diffraction.

In view of the immense potentialities of the new method for solving very large structures, it may be worthwhile developing experimental methods for measuring the intensities.

The author's grateful thanks are due to Professor Dorothy C. Hodgkin, F.R.S., N.L., O.M., Dr. B. T. M. Willis, Dr. David Dale, Dr. Guy Dodson and Mrs. Eleanor Collier for the many useful discussions he had with them and to the D.S.I.R., U.K., for the award of a visiting Fellowship to work at Oxford.

1. Coster, D., Knol, K. S. and Prins, J. A., *Z. Phys.*, 1930, **63**, 345.
2. Bijvoet, J. M., *Proc. Acad. Sci., Ams.*, 1949, **52**, 313; Peerdeman, A. F., Bommel, A. J. V. and Bijvoet, J. M., *Ibid.*, 1951, **54**, 16; *Acta Cryst.*, 1956, **9**, 1012.
3. Ramachandran, G. N. and Raman, S., *Curr. Sci., India*, 1956, **25**, 348.
4. Mark, H. and Szilard, L., *Z. Phys.*, 1925, **33**, 688.
5. Ramaseshan, S., Venkatesan, K. and Mani, N. V., *Proc. Ind. Acad. Sci.*, 1957, **46 A**, 95; *Curr. Sci.*, **26**, 352.
6. —, *Advanced Methods of Crystallography*, Academic Press, 1964.
7. Peterson, S. W. and Smith, H. G., *Phys. Rev.*, 1961, **6**, 7; *Jour. Phys. Soc., Japan*, 1962, **17**, 335; *Jour. de Phys. et la Rad.*, 1962, 191.
8. Johnson, C. K., Gabe, E. J., Taylor, M. R. and Rose, I. A., *Amer. Soc.*, 1965.
9. Dale, D., Hodgkin, D. C. and Venkatesan, K., *Crystallography and Crystal Perfection*, Academic Press, 1963, p. 237.
10. Breit, G. and Wigner, E., *Phys. Rev.*, 1936, **49**, 519.
11. Brockhouse, B. N., *Can. J. Phys.*, 1953, **31**, 432.
12. Rossmann, M. G., *Acta Cryst.*, 1961, **14**, 383; see Dickerson, R. E., *The Proteins*, Academic Press, N. Y., 1964, **2**; Karth, G. and Parthasarathy, R., *Acta Cryst.*, 1965, **18**, 745; Singh, A. K. and Ramaseshan, S. (under publication).
13. Phillips, D. C., *Sci. Instrum.*, 1965.

EXPRESSION AND STABILITY OF AN INDUCED MUTATION FOR EAR BRANCHING IN BREAD WHEAT

M. S. SWAMINATHAN, V. L. CHOPRA AND G. R. K. SASTRY

Indian Agricultural Research Institute, New Delhi

A MUTANT with adventitious branching in the ears simulating that found in nature in *T. turgidum* var. *mirabile* Korn ($2n=28$) was isolated in 1957 in the M_2 progeny of *T. aestivum* var. N.P. 797 ($2n=42$) treated with $10 \mu\text{C}$. per seed of S^{35} . When originally isolated, the mutant had ears in which the upper part was normal and a few of the lower notches of the rachis produced a pair of spikelets placed side by side and arranged at right angles to those of the normally placed single spikelets above. The mutant had about 15% pollen sterility and 30% seed sterility and gave rise to plants with both normal and branched ears, when seeds were sown from open pollinated heads. The proportion of plants with branched ears in open-pollinated progenies ranged from 9 to 54% in different years. Plants with normal ears isolated in the progeny of the branched ear

mutant also produced plants with the mutant ear phenotype, the percentage of such plants varying from 4 to 16 in different progenies. On selfing, the branched ear mutant bred true and in succeeding generations the penetrance of this gene showed remarkable enhancement. During 1964-65, the progenies of selected plants had ears with branches at nearly all the rachis nodes (Fig. 1). The secondary ears, however, varied in number, length and development in the different tillers of the same plant, the maximum expression of this character being usually found in the mother shoot and the first two to three tillers.

Meiosis was regular in the true breeding branched ear mutant, the mean number of chiasmata per bivalent at M_1 being 2.3, a value similar to that of control. On an average, the ears of the mutant had, during 1964-65, 87.6

spikelets per ear, the comparable value in the parent strain, N.P. 797, being 36. The mutant had the same maturity period as N.P. 797 but was, however, dwarf (an average height of 97.9 cm. in contrast to 126.5 cm. of normal N.P. 797). The dwarf nature was always associated with the ear branching habit, the plants with normal ears in the progeny of the open-pollinated branched ear mutant being always tall. The variety N.P. 797 is apically awnleted but branched ear mutants with both the parental type of awning as well as well-developed awns were isolated. Both these types of mutants have the dwarf habit.

dwarfing gene present in Sonora 63 is different from that of the N.P. 797 branched ear mutant and that a deletion may be responsible for the coincident dwarfing and ear branching found in the N.P. 797 mutant. Differential transmission of the deletion in the pollen and egg cells may cause disturbance in the observed phenotypic ratios.

Plants with branched ears have so far been reported in *Triticum* mostly in derivatives of interspecific or inter-generic crosses.^{1,2} Unlike the branched types isolated by Sharman¹ in the *T. aestivum* × *T. turgidum* hybrid, the N.P. 797 branched type was stable, the expression being

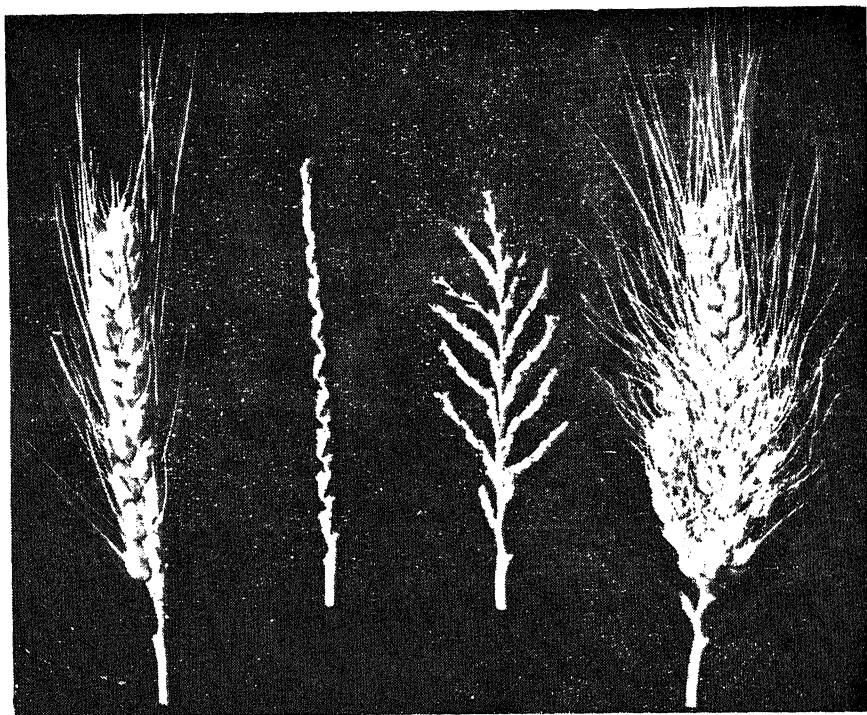


FIG. 1. Whole ear and ear without spikelets of (left) N.P. 797 and (right) branched ear mutant of N.P. 797.

Crosses were made in 1963 between the branched ear mutant and Sonora 63, a spring wheat variety with a single gene for dwarfing. The F_1 plants had normal ears and tall habit. There was a prominent heteromorphic bivalent at M-I in the F_1 plants. In the F_2 , segregation occurred for ear branching and plant height. About 9% of the F_2 population had branched heads and all plants with ear branching were also dwarf. This suggests that the "Norin"

environment-independent. The dwarf-cum-branched ear mutant of N.P. 797 hence offers distinct possibilities for the release for commercial cultivation in the near future of a branched wheat variety capable of giving high yields under favourable agronomic conditions.

1. Sharman, B. C., *Nature*, 1944, **153**, 497.
2. Tsitsin, N. V., In *Hybrids of Remote Crossings and Polybrids*, U.S.S.R. Academy of Sciences Publishing House, 1963, p. 25.

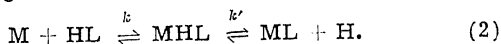
LETTERS TO THE EDITOR

ANALYSIS OF SPECTROPHOTOMETRIC DATA BY THE METHODS OF NEWTON AND ARCAND, AND McCONNELL AND DAVIDSON

SPECTROPHOTOMETRY has often been used for the determination of stability constants of 1:1 complexes formed in a reaction



The observed data can often be conveniently analysed by the methods described by Newton and Arcand¹ and McConnell and Davidson² which are fundamentally similar. The purpose of this note is to discuss these methods in a generalised way and to derive expressions for finding out stability constants in a situation in which two complex species such as ML and MHL exist in equilibrium in a reaction of the type



Recent investigation carried out by the authors on the stability constants of rare-earth complexes of 5-sulphosalicylic acid have shown that equilibria of this type are quite common at least in these complexes.³

Newton and Arcand studied complex formation between Ce^{+3} and SO_4^{-2} spectrophotometrically and derived an expression based on the fact that the ligand had no absorption at the wavelength studied. For reaction (1) it can be written as

$$-\frac{1}{K} \cdot \frac{D - D_{TM}}{a} + D_1 = D \quad (3)$$

where D is the observed optical density; D_{TM} the optical density of the solution when no complexing agent is added; D_1 , the optical density due to the complex ML when all the metal is complexed; ' a ' the free ligand concentration; and K , the stability constant. The slope of the straight line obtained by plotting D against $D - D_{TM}/a$ gives the value of K . In this method the free ligand concentration must be obtained by the method of successive approximations.

If the metal, the ligand and the complex all have absorption at the wavelength under study, the expression given above must be modified as follows:

$$-\frac{1}{K} \cdot \frac{(D - D_L - D_0)}{a} + D_1 = (D - D_L - D_0). \quad (4)$$

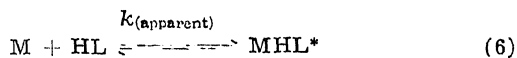
Here D_L is the optical density due to the free ligand and D_0 that of the free metal. In practice, one generally knows the optical density of the total ligand D_{TL} (instead of D_L) and of the total metal D_{TM} (instead of D_0). It is then convenient to evaluate a quantity $\bar{D} = D - D_{TL} - D_{TM}$ which is proportional to $(D - D_L - D_0)$; the proportionality factor is $(\epsilon_{ML} - \epsilon_L - \epsilon_0)/\epsilon_{ML}$, where ϵ_{ML} , ϵ_L and ϵ_0 are the extinction coefficients of the complex, the ligand and the metal respectively. The slope of the straight line obtained by plotting \bar{D} against \bar{D}/a then gives the stability constant as before but the intercept is now $D_1 \cdot (\epsilon_{ML} - \epsilon_L - \epsilon_0)/\epsilon_{ML}$.

McConnell and Davidson's method takes into account the total metal and the total ligand concentrations. The general form of the expression is

$$\frac{l \cdot T_M \cdot T_L}{D} = \frac{T_M + T_L}{\Delta \epsilon} + \frac{1}{K \Delta \epsilon} \quad (5)$$

where T_M is the concentration of the total metal; T_L , the concentration of the total ligand; l , the path length through which the light travels and $\Delta \epsilon = \epsilon_{ML} - \epsilon_L - \epsilon_0$. The linear plot of $l \cdot T_M \cdot T_L / \bar{D}$ against $(T_M + T_L)$ has a slope of $1/\Delta \epsilon$ and the intercept of $1/K \Delta \epsilon$ from which the stability constant of 1:1 complex can be easily calculated.

Let us now consider reaction (2) in which two complex species MHL and ML coexist. If the experiment is carried out at constant pH by keeping the metal concentration constant and varying the ligand concentration, it is possible to get a mixture of the two species, the concentrations of MHL and ML being related to each other by a constant factor $[H]/k'$. For the reaction



where $[MHL]^* = [ML] + [MHL]$, at constant pH, $k_{(apparent)}$ is given by the relation

$$k_{(apparent)} = \frac{[ML] (1 + C)}{\{T_M - [ML] (1 + C)\} a} \quad (7)$$

where

$$C = \frac{[H]}{k'} = \frac{[MHL]}{[ML]}$$

Since

$$[ML] = \frac{(D - D_L - D_0)}{\epsilon_{ML}}$$

we get

$$-\frac{1}{k_{(\text{apparent})}} \cdot \frac{(D - D_L - D_0)}{a} + \frac{T_M \cdot \epsilon_{ML}}{(1 + C)} \quad (8)$$

when all the metal is complexed, T_M is the sum of the concentrations of ML and MHL. Therefore, $T_M = [ML]_{\text{max.}} (1 + C)$.

Defining

$$\frac{T_M \cdot \epsilon_{ML}}{(1 + C)} = D_1^*$$

where D_1^* represents the optical density when all the metal is complexed as (ML + MHL), we obtain an expression

$$(D - D_L - D_0) = D_1^* - \frac{1}{k_{(\text{apparent})}} \times \frac{(D - D_L - D_0)}{a} \quad (9)$$

This expression is similar to the generalised expression (4) of Newton and Arcand. As discussed earlier, \bar{D} can be plotted against \bar{D}/a to get the value of $k_{(\text{apparent})}$. Incidentally the intercept of this straight line on \bar{D} axis is now

$$\frac{D_1^* \{ \epsilon_{ML} - (1 + C) (\epsilon_L + \epsilon_0) \}}{\epsilon_{ML}}$$

McConnell and Davidson's expression can also be used to analyse such data. Expression (5) is still the correct expression for getting $k_{(\text{apparent})}$; however, $\Delta \epsilon$, under these circumstances, is equal to

$$\frac{\epsilon_{ML} - (1 + C) (\epsilon_L + \epsilon_0)}{(1 + C)}$$

From the value of $k_{(\text{apparent})}$, it is possible to calculate k in reaction (2) if the concentration of ML can be ascertained by a suitable method.

This type of analysis can be applied in circumstances in which one of the two species ML and MHL or both the species have absorption at some suitable wavelength.

Our thanks are due to Shri S. Fareeduddin, Head, Chemical Engineering Division, Atomic Energy Establishment, Trombay, for his keen interest and encouragement.

Chemical Engineering Division, N. V. THAKUR.
Atomic Energy Establishment,
Trombay, Bombay-74,
and

Tata Institute of C. R. KANEKAR.
Fundamental Research,
Bombay-5, November 10, 1965.

ANTIBIOTIC ACTIVITY OF *SCLEROTIUM ROLFSSII* SACC.

IN an earlier communication some aspects of the study of oxalic acid production by *Sclerotium rolfssii* have been described.¹

So far, the studies on *S. rolfssii*, the causative organism of the root rot disease of many host plants, have been mainly directed towards its phytotoxicity and the considerable amount of oxalic acid produced has been incriminated as the toxic agent.² The inhibition of growth of a soil micro-organism of bacillus species by the culture filtrates of *S. rolfssii* has recently been reported.³

Since many plant pathogens are known to produce substances which besides phytotoxicity also exhibit inhibitory action on many soil micro-organisms and on human pathogens,^{4,5} antibiotic production by *S. rolfssii* has been studied and reported in this communication.

MATERIALS AND METHODS

The strain studied was isolated from diseased bean plant and maintained on potato dextrose agar. For antibiotic screening, the fungus was grown on nutrient peptone broth (Peptone 5 g., Beef extract 3 g., and distilled water 1000 ml.) at pH 6.0. Flasks containing this medium were inoculated with a single sclerotium and incubated at room temperature. Culture filtrate after 30 days incubation was used for the preliminary screening test for antibiotic action.

Test organisms.—These included pathogenic bacteria and fungi. *Staphylococcus aureus*, *Escherichia coli*, *Shigella dysenteriae*, *Salmonella paratyphi*, *Candida albicans*, *Cryptococcus neoformans*, *Trichophyton interdigitale*, *Aspergillus flavus*, *Erwinia carotovora*, *Pseudomonas fluorescens*, *Alternaria brassicae*, *Fusarium orthoceras*, *Helminthosporium arecae* and *Pestototia* sp. These organisms were seeded in suitable culture media in petri dishes. The standard agar cup plate method was used for the evaluation. As the rates of growth of the organisms differ, the zone of inhibition was noted when fair amount of growth of the organisms was observed in the control areas. Hence the time of recording varied from 18 hours in the case of *S. aureus* to 6 days with *T. interdigitale*.

The optimum period for maximum antibiotic activity was determined by testing the culture filtrate at varying intervals of incubation against *S. aureus*.

For the isolation of the active principles, solvent extraction procedure adopted was as follows ;

1. Newton, T. W. and Arcand, G. M., *J. Am. Chem. Soc.*, 1953, **75**, 2449.
2. McConnell, H. and Davidson, N., *Ibid.* 1950, **72**, 3164.
3. Thakur, N. V., Jogdeo, S. M. and Kanekar, C. R., Communicated for publication.

The culture filtrate after 20 days incubation, at which period the crude filtrate showed the maximum antibiosis, was extracted exhaustively with ether. The residue was further extracted with benzene and chloroform. The solvent extracts and the crude filtrate were evaporated to dryness under reduced pressure. Varying concentrations of the dried material were taken in alcohol and screened for antibiotic activity on *S. aureus* by the cup plate method.

The minimum inhibitory concentration of the extracts on *S. aureus* was determined in the liquid nutrient broth medium by the serial dilution technique. The extent of inhibition after 24 hours incubation was estimated by turbidimetric measurements.

Considering the possibility that oxalic acid which is one of the main metabolic products of this organism might itself be the antibiotic principle, the amount of oxalic acid present in the culture at the time of antibiotic assay of the culture filtrate was determined by permanganate titration method.⁹ Oxalic acid at this level and also three times this concentration were taken in nutrient broth and tested for antibiotic activity. The culture filtrate which favoured the maximum oxalic acid synthesis was also tested for antibiotic activity. The ether extract showing potent antistaphylococcal activity was chromatographically analysed for the presence of oxalic acid using Whatman No. 1 filter-paper, butanol : acetic acid : water (4 : 1 : 5) as the solvent and 0.04% bromophenol blue in 95% alcohol as the spraying agent.

RESULTS

The crude culture filtrate exhibited inhibition of growth on only *Staphylococcus aureus*. The extent of inhibition during incubation is shown in Table I.

TABLE I
Anti-staphylococcal activity of the culture filtrate

Days of incubation	..	4	8	12	16	20	24	28
Zone of inhibition (in mm.)		20	21	26	30	30	28	20

TABLE II
Inhibitory activity of the ether extract of *S. rolfsii*

Concentration/ml. ..	5 mg.	1 mg.	100 µg.	50 µg.
Zone of inhibition (in mm.)	48.5	41	37.5	25.5

Maximum antibiotic activity appears to have been reached by about sixteen days.

The ether extract of the culture, tested in various concentrations on *S. aureus*, gave the following inhibition (Table II).

The serial dilution study showed the ether extract to be bacteriostatic at 1 µg./ml. level and bactericidal at 100 µg./ml.

Benzene and chloroform extracts obtained from the residue were inactive.

That oxalic acid was not the inhibitory agent was proved by the absence of this acid in the ether extract by chromatographic analysis as also by the non-inhibition of staphylococcal growth in concentrations three times than that present in the cultures. Also, the culture filtrate from glucose peptone broth medium inducing maximum oxalic acid was non-inhibitory to *S. aureus*.

It is thus seen that *S. rolfsii* produces, besides oxalic acid, antibiotic substances specifically active against *S. aureus*. Glucose peptone medium, the most favoured one for oxalic acid synthesis, exhibits the least antibiotic activity while nutrient peptone medium, a poor supporter for oxalic acid production is a good medium for antibiotic production. The antibiotic is easily extractable with ether and is bacteriostatic to *Staphylococcus aureus* even at 1/1 million dilution.

Pharmacology Laboratory, JOSEPH BAGYARAJ.
Indian Institute of Science, M. SIRSI.
Bangalore-12, December 15, 1965.

1. Joseph Bagyaraj and Sirsi, M., *Curr. Sci.*, 1965, **34**, 458.
2. Higgins, B. B., *Phytopath.*, 1927, **17**, 417.
3. David, K. A. V. and Rao, A. S., *Ibid.*, 1965, **55**, 121.
4. Kalyanasundaram, R., *J. Madras Univ.*, 1963, **33 B**, 140.
5. Tirunarayanan, M. O., *Ph.D. Thesis, Studies on the Antibiotics of Fusarium and Their Mode of Action*, 1955.
6. Gaumann, E., Naef-Roth, Naef-Roth, S. and Kobel, H., *Phytopath. Z.*, 1952, **20**, 1.
7. Ishibashi, K., *J. Agr. Chem. Soc. Japan*, 1961, **35** (1), 253.
8. Braun and Armie, C., *Phytopath.*, 1959, **45**, 659.
9. Currie, J. N. and Thom, C., *J. Biol. Chem.*, 1915, **22**, 287.

FISH REMAINS FROM THE MIDDLE PALAEOZOIC OF THE KASHMIR HIMALAYAS

WHILE engaged on investigations in the Palaeozoic rocks of the Kashmir Himalayas the author found some specimens, *in situ*, of fish remains near Margan Pass (33° 44' : 75° 32') from the black calcareous shales immediately underlying the white Muth Quartzite exposed on the talus covered slopes, S.W. of Margan Pass.



FIG. 1. Medio-dorsal plate.

This is the first find of fish remains from the Middle Palaeozoics of the Indian Sub-continent.

The present specimen has a medio-dorsal plate (Fig. 1) and a few scales (Fig. 2). It can be tentatively identified as a species of *Holonema* Newberry and resembles *Holonema* sp. idet as described by J. Rade¹ from the Mt. Jack Area, New South Wales, Australia. Gross² has described a medio-dorsal plate of *Holonema eifeliense* Kaysen which resembles Kashmir specimen but with small pits on the anterior part of the plate.

The author thanks Prof. M. R. Sahni under whose guidance the present work has been carried out.

Department of Geology, V. J. GUPTA.
Panjab University,
Chandigarh, September 4, 1965.

1. Rade, J., *Journ. Pal.*, 1964, 38 (5), 929.

2. Gross, W., *Palaeontographica*, 1933, 79, Abt. A, 1.

LAMPROPHYRIC DYKE FROM CHANNAKAL BETTA, KUSHALNAGAR, MYSORE STATE

A LAMPROPHYRIC dyke is observed amidst granite, at Channakal Betta Δ 3295 (N. $12^{\circ} 28' 57''$; E. $75^{\circ} 59' 25''$), near Kushalnagar, Coorg District, Mysore State.

The dyke is one mile long and trends N. 30° E, with an average width of about 5-6 ft. Both the dyke and the country rock are traversed by two sets of vertical joints trending N. 30° E. and N. 30° W. The dyke rock has a dark grey colour with Sp. Gr. of 3.09. It is fine-grained at the margins and relatively coarse towards the centre.

Under the microscope the rock is essentially composed of pyroxene, olivine and plagioclase

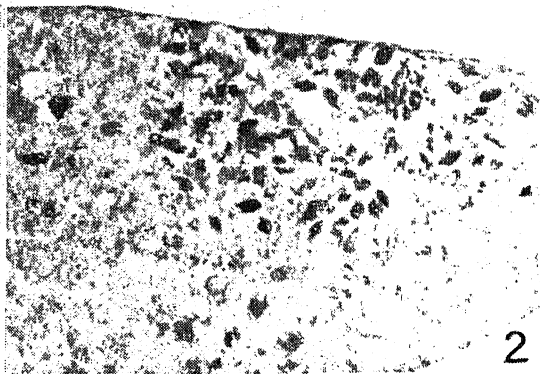


FIG. 2. Fish scale.

feldspar with accessory minerals like biotite and iron ore.

The olivine is euhedral to subhedral with a pale brown colour, and feeble pleochroism due to the presence of dusty inclusions. It is biaxial positive with $+2V = 84^{\circ}-90^{\circ}$ and birefringence $= 0.027-0.038$. The dominant pyroxene is nearly colourless and occurs as euhedral grains and prismatic plates with two sets of cleavages cutting at 90° . A few grains exhibit simple contact twinning with composition plane parallel to 110. Cruciform twinning is rarely observed in a few grains (Fig. 1). It

FIG. 1. Cruciform twinning in pyroxene. Plane polarized light, $\times 40$.

is optically biaxial positive with $+2V = 78^{\circ}-88^{\circ}$ and birefringence $= 0.007-0.011$. The above characters indicate the mineral to be enstatite.

Plagioclase is the only salic mineral of the dyke. It occurs in the form of slender twinned laths forming the matrix along with smaller grains of pyroxene. Out of the 15 grains examined for the twin laws, 7 exhibited Albite law, 3 exhibited complex Manebach-Ala Acline law, one each Manebach-, Baveno-, Carlsbad-,

Pericline- and Complex Albite-Carlsbad law. A few untwinned laths however exhibit zoning and a variolitic pattern in distribution. The anorthite content (55-70%) indicates that it is labradorite. It is optically positive, with $+2V = 80^{\circ}-90^{\circ}$.

The modal composition of the coarse textured portion determined on Shand's 6-Spindle integrating stage shows: Olivine 5.7%; enstatite 55.65%; plagioclase 34.9%; biotite 2.67% and iron ore 3.08%.

In thin sections, the chilled margin of the dyke exhibits a porphyritic texture, wherein a few bigger euhedral and marginally corroded grains of pyroxene and olivine occur as phenocrysts in a fine matrix (Fig. 2), but the central

the descriptions of Grout (1932) and Bowen (1928).

Absence of well-developed rectangular laths of plagioclase feldspar in the chilled margins indicates that this dyke has intruded the granite, before the complete development of plagioclase feldspar, as suggested by Ramsay (1955). Further, the dyke might have resulted by the injection of crystals of olivine and pyroxene into an alkalic liquid as observed by Jaffe (1953) in the case of Camptonites of Mount Jo.

The authors express their sincere thanks to Professor M. N. Viswanathiah for critically going through the script. The junior author is indebted to the Council of Scientific and Industrial Research, New Delhi, for financial assistance. Assistance of Sri. Ramakrishnaraju for the photomicrographs is much appreciated.

Dept. of Geology, B. V. GOVINDA RAJULU.
Manasagangotri, ASADULLA SHARIFF.
Mysore-2, September 8, 1965.

1. Lowen, N. L., *The Evolution of the Igneous Rocks*, Dover Publications, Inc., New York, 1956.
2. Grout, F. F., *Petrography and Petrology*, McGraw-Hill Book Co., Inc., New York, 1932.
3. Jaffe, H. W., *Am. Mineral.*, 1953, **38**, 1065.
4. Ramsay, J. G., *Geol. Mag.*, 1955, **92**, 297.

ON THE ABNORMAL GENITAL SYSTEM IN THE LEECH *HIRUDINARIA GRANULOSA* (SAVIGNY)

DURING a study on the Indian cattle leech *Hirudinaria granulosa* (Savigny), a very unique and abnormal genital system was observed. Relatively few reports have appeared in the literature concerning the abnormalities in leeches. Moore (1927) has mentioned variations in the sensillæ, whereas Bhatia (1938) has described the variations in the number of sensillæ and eyes, the posterior sucker, the structure of the crop, the variable number of testes and the extension of vas deferens in testesless segments where they have no function. The abnormalities in the genital system of this species seem to be unobserved so far, specially the development of double vagina and the association of male and female gonads in one and the same segment. Considering this case to be a unique one, an attempt has been made to record it here.

Typically in this species (Bhatia, 1941), the epididymes are paired and contained in segment X. Their ejaculatory ducts open in the atrium. First pair of testes lies in segment XII. Vas deferens run forward from segment XXII to segment XI where they abruptly enlarge to

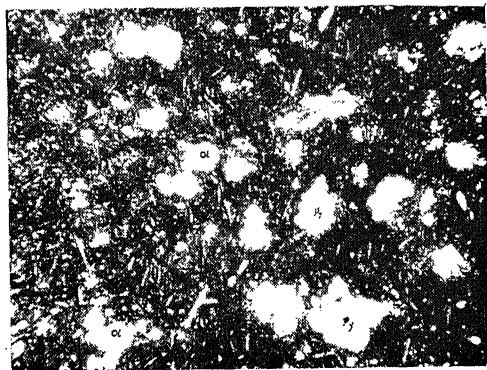


FIG. 2. Phenocrysts of olivine (ol) and pyroxene (py) in a fine-grained matrix. Plane polarized light, $\times 18$.

portion shows a typical panidiomorphic texture, wherein euhedral grains of olivine and pyroxene are embedded in a ground mass of fine granular pyroxene and lath-shaped plagioclase (Fig. 3).

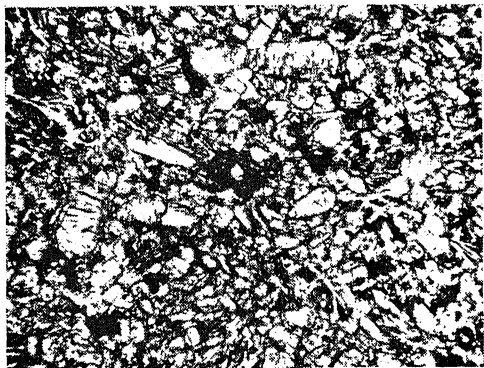


FIG. 3. Panidiomorphic texture from the core of the dyke. Plane polarized light, $\times 18$.

Based on the mineralogical and textural characteristics the dyke under investigation may be called a camptonitic lamprophyre following

form two closely convoluted and compact masses, the sperm vesicles or epididymes. The paired ovaries are contained in the ovisacs in segment XI, their oviducts leading to the vagina after uniting into a common oviduct. The vagina lies in the posterior part of segment XI.

The genital system under observation shows extremes of abnormalities. Both the male and female systems of the left side alone are abnormally developed.

The Abnormal Male Genital System.—The epididymis of the left side has descended to segment XI and consequently it receives the vas deferens which commences from segment XXIII instead of from segment XXII. The ejaculatory duct of the descended epididymis has lost all connections with the atrium; instead, passing under the nerve cord it is connected below the albumen gland with the oviduct leading to the normal vagina of the XI segment (Fig. 1 EJD.). The vas deferens

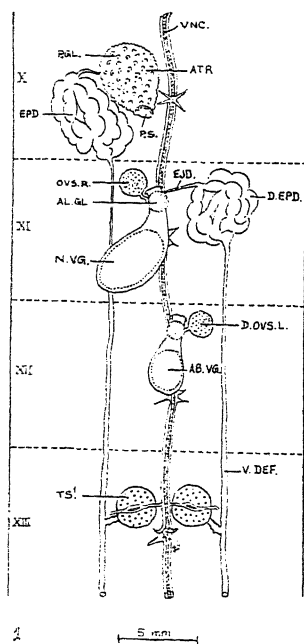


FIG. 1. Semi-diagrammatic sketch of the abnormal genital system in the leech *Hirudinaria granulosa* based on a photograph of the dissection. AB. VG., Abnormal vagina; AL. GL., Albumen gland; ATR., Atrium; D. EPD., Descended epididymis of the left side; D. OVS. L., Descended ovisac of the left side; EJD., Ejaculatory duct leading to the oviduct of the normal vagina; EPD., Epididymis of the right side; N. VG., Normal vagina; OVS. R., Ovisac of the right side; P. GL., Prostate gland; P. S., Penis-sac; TS., First pair of testes; V. DEF., Vas deferens; VNC, Ventral nerve cord.

of the right side runs normally from segment XXII where lies the tenth pair of testes. The first pair of testes lies in the segment XIII

instead of in segment XII; whereas the eleventh testis in segment XXIII is unpaired. The male genital aperture is distinct and normal.

The Abnormal Female Genital System.—The left ovisac has descended one segment, that is, it is in segment XII instead of in segment XI. Its oviduct leads to a new vagina which is nearly half the size of the normal vagina. The development of this double vagina is unique. It opens to the exterior, on the left side of the nerve cord, in a separate female genital aperture, distinctly in the mid-ventral line in the second annuli of segment XIII. Normal vagina has also its distinct female genital aperture on the second annuli of segment XII. Thus there are two very distinct female genital apertures, one each in segment XII and XIII.

The fact, that both the male and female reproductive organs (except the atrium and penis) of the left side are abnormal, and have descended a segment, is sufficient to prove that some strong stimulus led to this abnormal development of genital system in this leech. Since Hirudinea are almost certainly derived from Oligochaeta with paired ovaries and oviducts, it is very interesting to note that the ovaries are not paired here; one is in segment XI and the other is in segment XII. The nerve cord runs between them.

Since leeches are protandrous hermaphrodites and cross-fertilization is the general rule (Mann, 1962) the association of the ejaculatory duct with the oviduct of the normal ovary leads to the possibility of self-fertilization. This is further strengthened by the complete development of the normal ovary and the vagina as well as of the descended epididymis.

The development of another vagina in segment XII, its association with the ovary and its distinct female genital aperture, are other features of interest.

We are grateful to Dr. K. H. Mann of the University, Reading, Berkshire, England, for helpful suggestions and to Shri B. S. Varma of Regional Research Laboratory, Jammu (J & K), for helping us in our access to the literature.

Department of Zoology, K. P. BHATNAGAR.
Government College, A. K. SHIVASTAVA.
Guna (M.P.), July 21, 1965.

1. Bhatia, M. L., *Curr. Sci.*, 1938, 6, 438.
2. —, *Hirudinaria*. *Indian Zool. Mem.*, 1941, 3.
3. Mann, K. H., *Leeches (Hirudinea): Their Structure, Physiology, Ecology and Embryology*, Pergamon Press, 1962.
4. Moore, J. P., *Fauna of British India, 'Hirudinea'*, 1927.

FATTY ACID COMPOSITION OF THE
FAT IN THE TWO SEXES OF THE
OYSTER, *CRASSOSTREA MADRASENSIS*
(PRESTON)

DEPOT fats, which vary considerably in different species of organisms, have been little studied in marine invertebrates. Most of the studies have been so far on the total fat content based on insufficient or small samples. Relatively very little is known regarding the composition of the fat. Toyama, Takagi and Tanaka¹ studied the fatty oils of a variety of aquatic invertebrates. All other early investigations were related to the unsaponifiable fraction of mixed fat, pooled together from both sexes of the species.

I have been investigating the biochemical aspects of sex change in the common back-water oyster *Crassostrea madrasensis* and as a preliminary step have studied the analytical characteristics and fatty acid composition of the fat of male and female oysters separately. The present note records some of the chief differences in the analytical constants and the major fatty acids of the depot fat in the two sexes of the oyster.

The analytical constants of fat, viz., saponification value, iodine value, acid value, Reichert-Meissl and Polenske value were determined according to the methods given by Lewkowitsch and Warburton,² and Bolton.³ Unsaponifiable matter and ester fatty acids were separated adopting the method suggested by Viswanathan *et al.*⁴ The mixed fatty acids thus obtained were subjected to reversed phase paper chromatography, following the method suggested by Viswanathan and Meera Bai.⁵

The results obtained are given in Table I.

It will be seen that the fatty acid composition differs in the two sexes. In the male the fat has a higher proportion of unsaturated fatty acids (as shown by the iodine value) and in the female the fat has a higher percentage of saturated fatty acids.

Differences in the fat of the two sexes are also seen in regard to the percentage of water-insoluble and water-soluble fatty acids, free fatty acids and unsaponifiable matter.

Apart from the above differences, a noteworthy feature is the absence of myristic acid in the male specimens, but not in the female. Myristic acid is generally an important constituent of animal fats and hence its absence is remarkable.

We know little regarding the variations in composition of animal fat during the life-history

of the animal and with reference to sex. However, Lovern⁶ has reported the preferential utilization of fatty acids of C₂₂ (but not C₁₁) series, and that the concentration of fatty acids of C₁₄, C₁₈ and C₂₀ series falls in the female during the ripening of the eggs. This he attributes to the differential metabolic requirements in the two sexes.

TABLE I

	Female	Male
1. Colour of fat	.. Dark brown	Light brown and more-liquid
2. Percentage of fat	.. 13.7	13.4
3. Saponification value	258.0 ± 4.9	182.6 ± 3.38
4. Iodine value	.. 47.4 ± 0.405	85.3 ± 1.52
5. Acid value	.. 34.4 ± 0.15	29.8 ± 0.101
6. Saponification equivalent	217.5	309.9
7. Water-soluble volatile fatty acids	11.25	14.65
8. Water-insoluble volatile fatty acids	2.3	3.1
9. Molecular weight :		
Experimental	.. 346.2	312.5
Calculated	.. 342.3	314.0
10. Unsaponifiable matter	3.49	4.86
11. Major fatty acids	.. Lauric acid	Lauric acid
	Palmitic "	Palmitic "
	Stearic "	Stearic "
	Myristic "	..
	Oleic "	Oleic "
	Linoleic "	Linoleic "

What is noted in oyster is more than a preferential utilization or differential metabolic requirements during spawning, but characteristic patterns of structure of the fat in the two sexes.

I am grateful to Prof. R. V. Seshaiya for suggesting the problem and guidance.

U.G.C. Centre for V. K. VENUGOPALAN.
Advanced Study in
Marine Biology,
Porto Novo, September 10, 1965.

1. Toyama, Y., Takagi, T. and Tanaka, T., *Mem. Fac. Engineering, Nagoya University*, 1955, 7, 1.
2. Lewkowitsch, J. and Warburton, G. H., *Chemical Technology and Analysis of Oils, Fats and Waxes*, MacMillan & Co. Ltd., London, 1921.
3. Bolton, E. R., *Oils, Fats and Fatty Foods: Their Practical Examination*, J & A. Churchill, London, 1928.
4. Viswanathan, C. V., Meera Bai, B. and Pillai, S. C., *J. Water Pollution Control Federation*, 1962.
5. — and —, *J. Chromatog.*, 1962, 7, 507.
6. Lovern, J. A., *Biochem. J.*, 1936, 30, 20.

PHOSPHORUS CONCENTRATION DURING RED-WATER PHENOMENON IN THE NEAR SHORE WATERS OF PORTO NOVO (S. INDIA)

AN interesting feature of phytoplankton which is of much significance in the economy of the sea is the appearance of "blooms". The blooming of the alga *Trichodesmium erythraeum* (Ehr.), which has a red colouring matter as well as green causes the so-called red-water phenomenon. Similar coloured plants of various other species may also bloom suddenly and give rise to "red-water phenomenon".

The red-water phenomenon has been reported from several seas and is often associated with mass mortality of fish and other marine organisms. In Indian waters the occurrence of this phenomenon due to *Trichodesmium* has been observed chiefly on the west coast and Gulf of Mannar. Chidambaram *et al.* (1944)³ observed the active swarming of *Trichodesmium erythraeum* (Ehr.) in Pamban area. Chacko and Mahadevan (1956)² reported the occurrence of red-water bloom of *Trichodesmium erythraeum* (Ehr.) in the Gulf of Mannar during the months of April, May, July, October and November. According to Chacko these blooms lasted for 3 to 7 days and were accompanied by heavy mortality of some marine animals. Chacko (1942)¹ also reported mass mortality in a fish pond near Krusadai Island due to *Trichodesmium erythraeum* (Ehr.). On the west coast of India, in Cochin, Prakash and Sarma (1964)⁵ reported red water during November 1963. Prabhu and Ramamurthy (1965)⁶ recorded swarming of *Trichodesmium* during March 1965 on the Mangalore coast.

We have so far no precise analysis of the casual factors whose interplay might result in the red-water phenomenon. These blooms depend evidently on the simultaneous presence of several factors, of which an abundant supply of nutrients is one. None of the authors mentioned above studied the changes in the concentration of any of the nutrients during the *Trichodesmium* bloom. On the Florida coast, during the red-water phenomena, due to the bloom of *Gymnodinium*, the total phosphorus content of sea-water was found to increase from 2½ to 10 times the maximum normally expected in sea-water (Ketchum and Keen, 1948).⁴

The present note records the occurrence of red-water phenomenon in Porto Novo waters resulting from a bloom of a *Trichodesmium*, which lasted for eleven days, from 7th March to 19th March 1965. The bloom was very striking. It stretched for about 6 metres in width and

extended for about 12 miles in length in the 7 to 10 fathoms line. No mortality of fish or other organisms was associated with this bloom. The changes in the total phosphate and inorganic phosphate in sea-water during the bloom are shown in Table I.

TABLE I

Date in March 1965	Total P μ gm. at p/l.	Inorganic P μ gm. at p/l.	<i>Trichodesmium</i> cells per ml.	Settling volume of plankton in c.c.	Salinity S ₀₀	Temperature ° C.
3	0.7	0.4	Traces	..	33.32	23.10
4	0.8	0.2	"	..	33.05	24.31
5	1.0	0.2	"	..	33.41	23.95
7	1.5	Nil	192	125	33.75	24.51
8	6.4	Nil	215	170	33.60	24.48
9	11.4	Nil	346	259	33.45	24.60
10	11.5	Nil	412	270	33.81	24.67
11	10.8	Nil	396	220	33.92	24.59
12	9.7	Nil	358	185	33.68	24.53
14	8.4	Nil	321	145	33.52	24.74
16	7.1	Nil	297	130	33.45	24.72
17	4.5	Nil	262	115	33.27	24.68
19	1.4	0.3	Traces	..	33.48	24.22
20	1.2	0.3	"	..	33.50	23.85
21	0.8	0.35	"	..	33.50	23.80

It will be observed that, from 3rd March to 5th March, when only traces of *Trichodesmium* were present, the inorganic phosphate in sea-water declined from 0.4 to 0.2 μ gm. at p/l. and the total phosphate increased gradually. Subsequently, with a rapid increase in *Trichodesmium* population the inorganic phosphate disappeared and the total phosphate in sea-water showed a corresponding increase. The bloom disappeared after 17th March, only traces of *Trichodesmium* cells being present. With the disappearance of bloom, the total phosphate in sea-water declined considerably and inorganic phosphate appeared.

During the peak period of the bloom, inorganic phosphate was entirely absent in the sea-water. As the total phosphate increased the inorganic declined and disappeared, when the total phosphate declined later the inorganic phosphate reappeared. It may not be unreasonable to infer that the appearance of the bloom has involved the utilization of inorganic phosphate and its conversion to organic form. The reappearance of inorganic phosphate with the disappearance of the bloom may be due to non-utilization of organic phosphate.

We may consider whether a terrigenous contamination could have contributed to this *Trichodesmium* bloom. During the bloom the

salinity of the water remained constant and there was no evidence of the dilution of the sea-water due to fresh-water drainage from land. The possibility of water-borne contamination from land sources being the cause of increase in total phosphate must therefore be excluded.

We have great pleasure in expressing our indebtedness to Prof. R. V. Seshaiya, Director, U.G.C. Centre in Marine Biology, for suggesting the problem and guidance. Our thanks are also due to Dr. L. H. N. Cooper, F.R.S., for helpful suggestions. One of us (V. D. R.) is grateful to the University Grants Commission for the award of a Junior Research Fellowship. U.G.C. Centre for V. D. RAMAMURTHY.
Advanced Study and R. SESHADRI.
Research in Marine Biology,
Porto Novo (S. India), September 3, 1965.

1. Chacko, P. I., *Curr. Sci.*, 1942, **11**, 404.
2. — and Mahadevan, S., *Fish. Stu. Repts. and Year-book*, April 1954, March 1955, Govt. of Madras, 1956, p. 139.
3. Chidambaram, K., *et al.*, *Curr. Sci.*, 1944, **13**, 263.
4. Ketchum, B. H. and Keen, D. J., *J. Mar. Res.*, 1948, **7**, 17.
5. Prakash, A. and Sarma, A. H. V., *Curr. Sci.*, 1964, **33**, 168.
6. Prabhu, M. S., *et al.*, *Ibid.*, 1965, **34**, 95.

A RARE RECORD OF LETHACOTYLE (MONOGENEA), ITS POST- ONCOMIRACIDIAL LARVA WITH OBSERVATION ON DISTRIBUTION

A COLLECTION of marine fishes from Andamans, obtained in February to March 1961, were examined for their parasites and from a single *Caranx sexfasciatus* (total length 15.5 cm.) available in that collection, one monogenetic trematode belonging to *Lethacotyle* Manter and Prince,¹ a post-oncomiracidial larva of *Lethacotyle* and fifteen monogenetic trematodes belonging to *Cemocotylella* Price² were collected.

There is so far no record of *Lethacotyle* since its first description by Manter and Prince¹ from Fiji in 1953. In view of the absence of clamps in it, Hargis³ considered this feature as reported by Manter and Prince,¹ though possible, is so unusual that further observations are necessary to confirm this condition. Since the present one is the second record of *Lethacotyle* and it confirms the observation of Manter and Prince,¹ it is of interest to report on the occurrence of the genus.

There is so far no record of the larva of *Lethacotyle* or of its related genera belonging to the family Protomicrocotylidae (Llewellyn⁴)

and the post-oncomiracidial larva reported here is the first record to be known in the family.

Lethacotyle recorded from Andamans differs from the one described by Manter and Prince¹ in that the posterior lobed portion of the body being on the left and the distal portion of the vagina on the right side of the worm. These and other differences observed will be included in a redescription of *Lethacotyle* to be published together with the larva elsewhere.

The record of *Lethacotyle* from Andamans is of interest from the point of geographical distribution. Monogenea have direct life-cycle and show high specificity so that it might be expected of them to show the same distribution as their hosts (Dawes⁵; Manter⁶). Though *Caranx sexfasciatus* and its related hosts occur along the coasts of peninsular India, they have yielded monogenea other than *Lethacotyle* (Chauhan⁷⁻⁸; Ramalingam⁹⁻¹¹; Tripathi¹² Unnithan¹³⁻¹⁵).

An intensive examination of *C. sexfasciatus* (total length ranging from 5.2 cm. to 26.5 cm.) netted from inshore and offshore waters around Mandapam over a two-year period did not yield *Lethacotyle*, but yielded *Cemocotylella*. The data obtained from the studies on carangid fishes at Madras show results similar to that obtained at Mandapam with the difference that *Cemocotylella* was found on *C. atropus* and was recorded only once.

Although *Lethacotyle* occurs along with *Cemocotylella* in the same host, the former is confined to fishes from Andamans whereas the latter is more widely distributed and has been recorded from Mandapam and Madras. Thus from the point of distribution, *Lethacotyle* shows a discontinuity. Such discontinuity in distribution is seen even in more successful digenetic trematodes of marine fishes like *Derogenes varicus*. Though this species has been recorded from well over 50 species of fishes all over the world, yet it has not been recorded from fishes of the coast of North Carolina and is absent from surface-water fishes of Tortugas (Dawes⁵). The significance of the restriction of *Lethacotyle* is not clear although it is suggestive that they are more susceptible to unfavourable conditions of the environment than *Cemocotylella*. That this may be so is supported by the observation of Manter,⁶ who considers that temperature may be a factor responsible for the discontinuous distribution of *Derogenes varicus* as it may have an effect on the intermediate host or hosts. It is possible that factors such as temperature may operate directly to a greater extent on monogenea than

digenea since the former are found in superficial locations in aquatic vertebrates and consequently are much exposed to changes in the environmental conditions.

The observations on the discontinuity in the distribution of *Lethacotyle* is significant in view of the statement made by Manter¹⁶ that "parasites of the same or related hosts now having a discontinuous distribution are of special interest because if the parasites in the two localities are the same or closely related the evidence of a former continuity and sympatry is strong".

Studies on the distribution of parasites similar to the one presented, if extended to more hosts from different regions, according to Manter,¹⁶ may give information not only about the ecology and travels of the host but also furnish evidence of origin and phylogeny of hosts. Further investigations on these lines are in progress.

I am grateful to Dr. G. Krishnan, Director, for his encouragement.

Zoology Laboratory, K. RAMALINGAM.
University of Madras,
Chepauk, Madras-5, September 9, 1965.

1. Manter, H. W. and Prince, D. F., *Proc. helm. Soc. Wash.*, 1953, 20 (2), 105.
2. Price, E. W., *J. Parasit.*, 1962, 48 (3), 402.
3. Hargis, W. J. Jr., *Trans. Amer. micr. Soc.*, 1957, 76 (1), 1.
4. Llewellyn, J., Larvæ and larval development of Monogeneans, in *Advances in Parasitology* (Edited by Ben Dawes), Academic Press, 1963, 1, 287.
5. Dawes, B., *The Trematoda with Special Reference to British and Other European Forms*, Cambridge Univ. Press, 1946. Pp. xvi+644.
6. Manter, H. W., *Exp. Parasit.*, 1955, 4 (1), 62.
7. Chauhan, B. S., *Proc. Indian Acad. Sci.*, 1945, 21 B (3), 129.
8. — *Rec. Indian Mus.*, 1953, 51 (2), 113.
9. Ramalingam, K., *Proc. natl. Inst. Sci. India*, 1960 a, 26 B (6), 367.
10. —, *J. zool. Soc. India*, 1960 b, 12 (1), 34.
11. —, *Zool. Anz.*, 1961, 165 (7/8), 286.
12. Tripathi, Y. R., *Indian J. Helminth.*, 1959, 9 (1-2), 1.
13. Unnithan, R. V., *Bull. Res. Inst. Univ. Kerala*, 1957, 5C (2), 27.
14. —, *Indian J. Helminth.*, 1961, 12 (2), 112.
15. —, *Parasitology*, 1962, 52 (3-4), 315.
16. Manter, H. W., *Systematic Zool.*, 1963, 12 (2), 45.

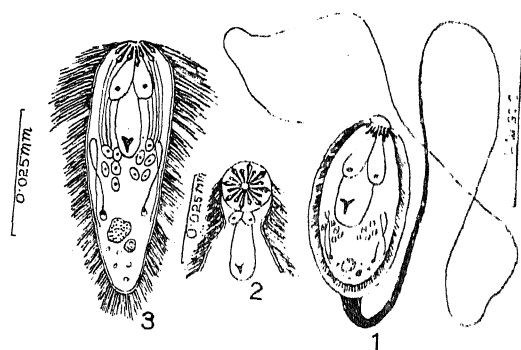
EGG AND MIRACIDIUM OF A GENARCHOPSID FLUKE (HEMIURIDAE) IN LOCAL FISHES

HEMIURID FLUKES, which are usually parasitic in oesophagus and stomach of fishes and sometimes reported from other lower vertebrates, have been described from Indian fresh-water

fishes.^{1,2} Out of a total of eleven species recognised by Yamaguti³ under the halipegine genus *Genarchopsis* Ozaki, 1925 (characterised by the posterior union of its intestinal caeca and possession of filamented eggs) as many as six species have alone been reported from *Ophiocephalus punctatus* and *O. striatus* and a seventh one from *Mastacembelus armatus*. These species: *G. lobata*,² *G. ovocaudata*,² *G. piscicola*,² *G. singularis*,² *G. dassus*,¹ *G. indicus*¹ and *G. faruquis*,¹ have been differentiated on such topographical variations as the position of genital pore, the presence or absence of oesophageal pouch, the lobed or compact character of vitellaria and the extent of the uterine coils. Adequate details of the structure of the embryonated egg including its filament and the contained miracidium are lacking.

The incidence of genarchopsid representatives without oesophageal pouch, in *O. punctatus*, *M. armatus* and *Mystus seenghala*, was ascertained by collecting adult specimens during different months. The embryonated eggs with the miracidia have been studied in tap-water and are briefly described here.

The oval eggs are straw-coloured, operculate, fully embryonated and carry a prominently long but tapering filament at the opposite pole (Fig. 1). These measure 0.046-0.07 mm.



FIGS. 1-3. Fig. 1. An egg with filament. Fig. 2. Apical crown of spines (dorsal view). Fig. 3. The miracidium.

0.023-0.032 mm. in size and the filament, with a broader base and pointed tip, is 0.276-0.358 mm. long. The contained embryo is clearly visible and exhibits such structural details as the characteristic anterior crown of spines placed against the operculum, the apical gland with the eye spot, the pair of penetration glands with the ducts lying lateral to the hind margin of the apical gland, the two flame cells with their sinuous ducts, and the masses of germ cells.

The eggs, left in tap-water for two weeks, remained unhatched. A slight pressure on the coverslip, however, easily liberated the miracidium through the opercular end. The protrusible apical crown contained sixteen pen-shaped spines in two distinct rows (Fig. 2). The prominent rows of cilia, in four distinct groups, had larger cilia in the anterior group occupying a comparatively greater area. Epidermal plates were not detected but the ciliated coat had below it a covering of squamous cells.

The miracidium (Fig. 3) measured 0.047–0.062 mm. in length and 0.020–0.028 mm. in maximum breadth. The larger spines measured 0.006–0.007 mm. in length and the smaller ones were 0.004–0.005 mm. long. The apical gland, granular and opaque in character, nearly reached the middle of the body in its extended form and distinctly showed, on each side, the five unicellular glands with their separate ducts. The brain mass and eye spot lay along the middle of its posterior region. A large unicellular penetration gland, with its prominent duct, was observed on either side of the apical gland in its anterior region. A pair of flame cells, lying at about two-third of the body length from the anterior end and with their sinuous ducts passing anteriorly and lying lateral to the five pairs of glands, was detected. Excretory pore was in level with the flame cells. Germ cells occurred in the posterior half of the body.

A study of the numerous stained and permanent mounts of the available adult specimens, on comparison with the accounts of the species so far described, emphasises the need for a re-examination and reassessment of the various forms so far described. In view of the confusion resulting from the extremely variable and intergrading characters that have been relied upon for specific differentiation, a correct identification of our material becomes difficult. Further, the sizes of the egg filaments do not seem to have correctly been recorded in the different forms. The present description of the egg and its miracidium might be useful in establishing the validity or otherwise of the known Indian forms in conjunction with or without the differential characters that have been utilised. Work in this direction is in progress.

Department of Parasitology, P. RAI.
U.P. College of Veterinary B. P. PANDE.

Science & Animal Husbandry,
Mathura (U.P.), August 5, 1965.

2. Srivastava, H. D., *Bull. Acad. Sc. Allahabad*, 1933, 3(1), 41.
3. Yamaguti, S., *Systema Helminthum*, Vol. I. *The Digenetic Trematodes of Vertebrates*, Parts 1 and 2. Interscience Publication, New York, 1958.

MEROZOITES FROM GLOBIDIAL SCHIZONTS IN ABOMASUM OF INDIAN GOATS

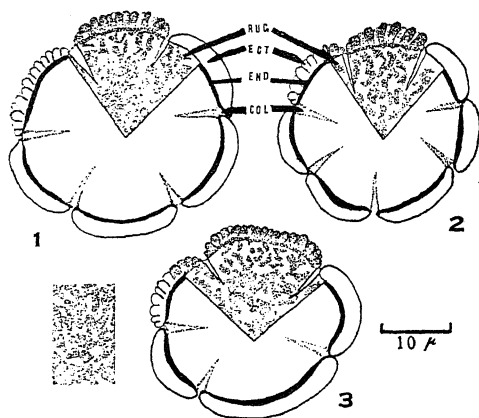
THE globidial cysts/nodules in abomasum of goats have been assigned to *Globidium gilruthi* (Chatton, 1910) by Sarwar (1951), Soliman (1958, 1960) and Ferguson and Goldsby (1961) who have given the sizes of these bodies and the sickle-shaped "spores" contained inside. Levine (1961) believed that these structures were schizonts and merozoites of *Eimeria gilruthi* (Chatton, 1910), Reichenow and Carini, 1937.

Of the hundred abomasa, available from local slaughter-houses during this month, nine were found to harbour giant eimerian schizonts—the so-called globidial cysts. These white rounded bodies, occurring mostly in the mucous membrane of the folds of the fundus of abomasum, could easily be located when the abomasum had been left for an hour in tap-water. Mature cysts, after extraction, measured $580-966 \mu \times 500-830 \mu$ while the developing forms ranged from $200-780 \mu \times 180-670 \mu$ in size. The distinctly double-layered cyst wall was upto 40μ in thickness.

Stained smears from the fluid taken from twenty-two mature schizonts, after adequate fixation in 90% alcohol and methanol pure and subsequent staining in Ehrlich's hæmatoxylin and eosin, revealed numerous crescent-shaped merozoites which, under oil immersion objective of Olympus phase-contrast microscope, occurred in three sizes. The largest merozoites, $9.0-12.3 \mu \times 1.2-1.5 \mu$ in size and more common than the two others, were straight or slightly curved and with tapering ends, the nuclear end being somewhat blunt. The oval or ellipsoidal nucleus lay about $1/3$ rd of the body length from the blunt posterior end (Fig. 1 a). Differences in size and shape were observed in the two other types. In the first type, the merozoites were $6.0-8.5 \mu \times 1.0-1.3 \mu$ in size, thin, slender and slightly curved in form and with tapering ends. The nearly oval or spherical nucleus was situated a little away from the centre but mostly towards the anterior pointed end (Fig. 1 b). The second type, with a comparatively robust and stumpy form and abruptly ending extremities, measured $5.0-7.7 \mu \times 1.5-1.7 \mu$ and the distinctly rounded

Rehman⁵ found 3 colpi in *C. chinensis* and *planiflora*, and 5 in *reflexa*. In *C. santapau* the colpi range from 5-7 in number.

1887 p.p.; Trimen, *Handb. Fl. Ceylon*, 4: 44, 1898.



FIGS. 1-3. Figs. 1-2. *C. santapau*; 6 and 7-colpate pollen grains. Fig. 3. *C. reflexa*; 5-colpate pollen grain; ECT—ectine; END—endine; COL—colpi; RUG—rugulae.

The senior author is thankful to the University of Kalyani for the grant of a scholarship.

Department of Botany, SITESH DAS.
University of Kalyani, M. L. BANERJI.
Kalyani (W. Bengal). April 13, 1964.

1. Banerji, M. L. and Sitesh Das, *Journ. Arn. Arb.* January 1965, 46 (1).
2. Erdman, G., *Pollen Morphology and Plant Taxonomy*, Angiosperms. Stockholm, 1952.
3. Johnston, I. M., *Journ. Arn. Arb.*, 1952, 33, 299.
4. Nair, P. K. K., *Bull. Natl. bot. Gard. (Lucknow)*, 1961, No. 53.
5. — and Rehman, K., *Ibid.*, 1963, No. 83.
6. Stern, K. R., *Amer. J. Bot.*, 1962, 49, 362.
7. Yuncker, T. G., *Torrey Bot. Club.*, 1932, 18, 109.

ANTIDESMA WALKERI—A NEW RECORD FOR INDIA

Antidesma walkeri (Tulasne) Pax & Hoffm. (Euphorbiaceae), known only from Ceylon so far, was collected in Agastyamalai Hills in Tirunelveli District, Madras State, at an altitude of about 700 m.; only few plants were located near Inchikuzhi, in moist deciduous forests. The occurrence of this species, at the southern end of the Western Ghats in India, forms an additional information about its distribution (Fig. 1).

Antidesma walkeri (Tulasne) Pax & Hoffm. in Engler, *Pflanzenr.*, 81: 118, 1922. *A. lanceolatum* var. *walkeri* Tulasne in *Ann. Sci. nat.* (Ser. 3), 15: 196, 1851; Muell.-Arg. in *DC. Prodr.*, 15 (2): 266, 1866. *A. lanceolarium* sensu Thw. *Enum. Pl. Zeyl.*, 289, 1864. *A. diandrum* sensu Hook. f., *Fl. Brit. India*, 5: 361,

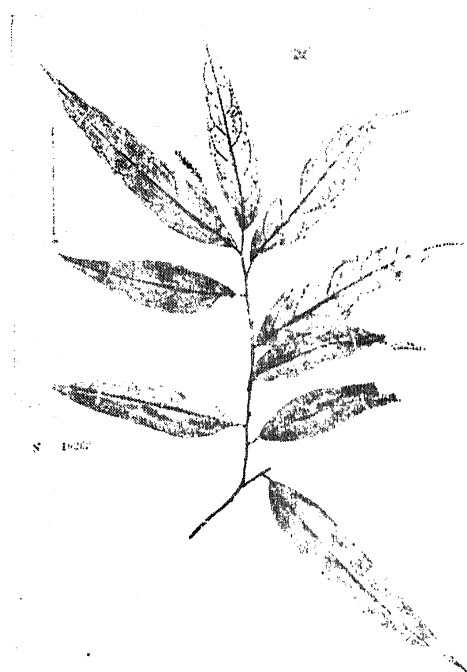


FIG. 1

This distinct species was included in *Antidesma diandrum* (Roxb.) Roth, by Hook. f. and was followed by Trimen. Trimen, *loc. cit.*, p. 45, states: "I follow *Flora of British India* in reducing this to *A. diandrum* with some doubt, as the flowers are never diandrous in Ceylon, nor does our plant agree in some other respects." The two species can be differentiated as follows:

Leaves lanceolate, acuminate to cuspidate-acuminate at apex; stamens 3-4. *A. walkeri*
Leaves elliptic or obovate, acute to shortly acuminate at apex; stamens 2. *A. diandrum*

For a full description of *A. walkeri* see Pax & Hoffm. *loc. cit.*

Herbarium specimens examined.—Henry 16262, collected on 25th May 1963, deposited in the Southern Circle Herbarium, Botanical Survey of India, Coimbatore (MH); this number matches well with the only Ceylon specimen (*Thwaites* 2602) of *A. walkeri* represented in the Central National Herbarium (CAL).

I wish to thank Dr. H. Santapau for the facilities extended and Dr. K. Subramanyam for going through the manuscript. I also thank Dr. K. M. Sebastine for providing facilities for collection of this species.

Botanical Survey of India, A. N. HENRY.
76, Acharyya Jagadish Bose Road,
Calcutta-14. September 17, 1965.

REVIEWS AND NOTICES OF BOOKS

Linear Sequential Switching Circuits. Edited by William H. Kautz. (Holden-Day, Inc., 728, Montgomery Street, San Francisco), 1965. Pp. v + 234. Price \$ 6.75.

The present volume under review brings together reprints of well-known papers comprising the important technical contributions in the theory of linear sequential switching circuits. This theory not only provides the fundamental basis for the design of error-detecting and error-correcting circuitry used with error-checking codes in communications and computers; it also constitutes an integral and central part of the theory of sequential digital networks in general, which theory lies at the heart of the design of digital logic circuitry such as is found in digital computers and control systems and in digital communication systems. The scope of this collection is almost entirely theoretical, and the material is fundamental in nature.

C. V. R.

Energetics in Metallurgical Phenomena. By William M. Mueller. (Based on the Proceedings of the 1962 Seminar on Energetics in Metallurgical Phenomena, University of Denver.) (Gordon and Breach, Science Publishers, 150, Fifth Avenue, New York-11), 1965. Pp. xiii + 425. Price: reference edition \$ 19.50; paperback edition \$ 9.50.

In a serious attempt to consolidate up-to-date thinking on the energetics approach to the study of metallurgical phenomena and to provide a means by which science faculty members and other researchers may keep abreast of this fast-moving field, the First Seminar on Energetics in Metallurgical Phenomena was held at the University of Denver in the summer of 1962. The Seminar was sponsored by the Department of Metallurgy at the University of Denver with financial support provided by a grant from the National Science Foundation. Eight one-week lecture series were presented, covering subjects of fundamental importance to an understanding of the behavior of materials.

This volume contains the subject-matter presented in these lectures. Their titles are as follows: 1. Intermetallic Diffusion, by David Lazarus; 2. Solid Solutions, by Rudolph Speiser; 3. Nucleation Processes, by Michael B. Bever; 4. Transformations, by Earl C. Roberts; 5. Metastable Phases Obtained by Rapid Solidifi-

cation, by Pol Duwez; 6. Annealing Mechanisms in Deformed Metals, by Paul Gordon; 7. Energetics in Dislocation Mechanics, by John E. Dorn; 8. The Oxidation of Metals, by Kenneth R. Lawless.

C. V. R.

An Atlas of Models of Crystal Surfaces. By J. F. Nicholas. (Materials Science and Engineering Program). (Gordon and Breach, Science Publishers, 150, Fifth Avenue, New York-11), 1965. Pp. 256. (9 × 12" format). Price \$ 27.50.

This volume is concerned entirely with the geometry of atomically-flat surfaces, defined in the following way. If an ideal crystal, consisting of an infinite regular array of atoms (or ions), is cut by a plane and all atoms whose centres lie on one side of this plane are removed, then the remaining half-crystal is said to possess an *atomically-flat surface*.

Ball models showing the atomic arrangements at such surfaces have been constructed for surfaces of about twenty different orientations in each of the face-centred cubic, body-centred cubic, sodium chloride, diamond, and hexagonal close-packed structures. In Section 1, the specification of a surface is discussed. In Section 2, the way in which the models represent crystal surfaces is explained, but details of the actual construction of the models are deferred to Section 5. This last section can be omitted without loss of understanding unless the reader is interested in actually constructing models for himself.

For each surface, a scaled plan of a unit cell of surface has been drawn and the exact positions of the surface atoms associated with this cell have been tabulated. The interpretation of these plans and tables is described in Section 3. Further, for each surface atom, the number of nearest neighbours has been found and the co-ordination type is listed in the table of atomic positions. The terminology is explained in Section 4. Again, the largest part of Section 4 (Section 4.3) can be omitted without serious loss unless the reader wishes to study the co-ordination of surface atoms in great detail. In particular, Sections 4 and 5 can be read independently of each other.

This book will be found to be of great value by practising surface chemists, physicists and crystallographers.

C. V. R.

nucleus was somewhat centrally placed (Fig. 1c). Numerous spherical residual masses were detected in these smear preparations.



FIG. 1. (a) Large-sized merozoites, (b) Small-sized merozoites, thin and slender form, (c) Small-sized merozoites, robust and stumpy form.

The size range in the larger-sized merozoites, in our material, accommodates the dimension given by Sarwar ($10.0\mu \times 1.5\mu$). The size mentioned by Soliman (1960), however, agrees in length but differs in a greater width ($10.0\mu \times 1.8\mu$) of the merozoites. The two smaller merozoites are within the size range indicated by Levine ($4.5-7.5\mu \times 1.2-2.0\mu$) who has, however, not mentioned whether the dimensions relate to merozoites in smears or sections. It is likely that the robust form, in our material, in the smaller-sized merozoites might really represent an earlier stage in development of the thin and slender of the smaller merozoites. Further work is in progress to determine their correct status. Our smear preparations have yielded more than one type of merozoites in the abomasal schizonts belonging to *Eimeria*. Specific determination has finally to await a complete elucidation of the endogenous stages in all the eimerian parasites of goat currently known from their oocysts.

Grateful acknowledgements are due to the University Grants Commission, New Delhi, for the award of a Junior Fellowship to one of us (B.B.B.) and to the Principal of the College for the facilities provided.

Department of Parasitology,
U.P. College of Vet. Science

and Animal Husbandry, Mathura,
June 30, 1965,

B. P. PANDE.
B. B. BHATIA.

1. Levine, N. D., *Protozoan Parasites of Domestic Animals and of Man*, Burgess Publishing Company, Minnesota, 1961, p. 412.
2. Ferguson, D. L. and Goldsby, A. I., *J. Parasit.*, 1961, **47**, 726.
3. Sarwar, M. M., *Parasitol.*, 1951, **41**, 282.
4. Soliman, K. N., *Ibid.*, 1958, **48**, 291.
5. —, *J. Parasit.*, 1960, **46**, 29.

IN VITRO CULTURE OF EXCISED EMBRYONAL AXES OF *CLITORIA* *TERNAETA* LINN.

THE cultivation of isolated embryonal organs in sterile culture adds to our knowledge of morphogenesis in the embryo. This method of experimental study is also useful in assessing the relationships between embryonal organs. Isolated embryo segments like hypocotyl, epicotyl and cotyledonary node have already been grown successfully in culture (see Kusum Kanta and Padmanabhan, 1964).

In the present study excised embryonal axes of *Clitoria ternatea* were grown on nutrient agar. Nitsch's (1951) basal medium supplemented with vitamins was found to be ideal for normal growth of embryonal organs. Embryos were dissected out aseptically from green pods which were previously surface-sterilized by immersion in chlorine water for 15 minutes. After severing the cotyledons, the axis was planted in nutrient agar. The tubes were placed in a culture room maintained at $24^{\circ}\text{C} \pm 1^{\circ}\text{C}$. and with 12 hours of illumination per day.

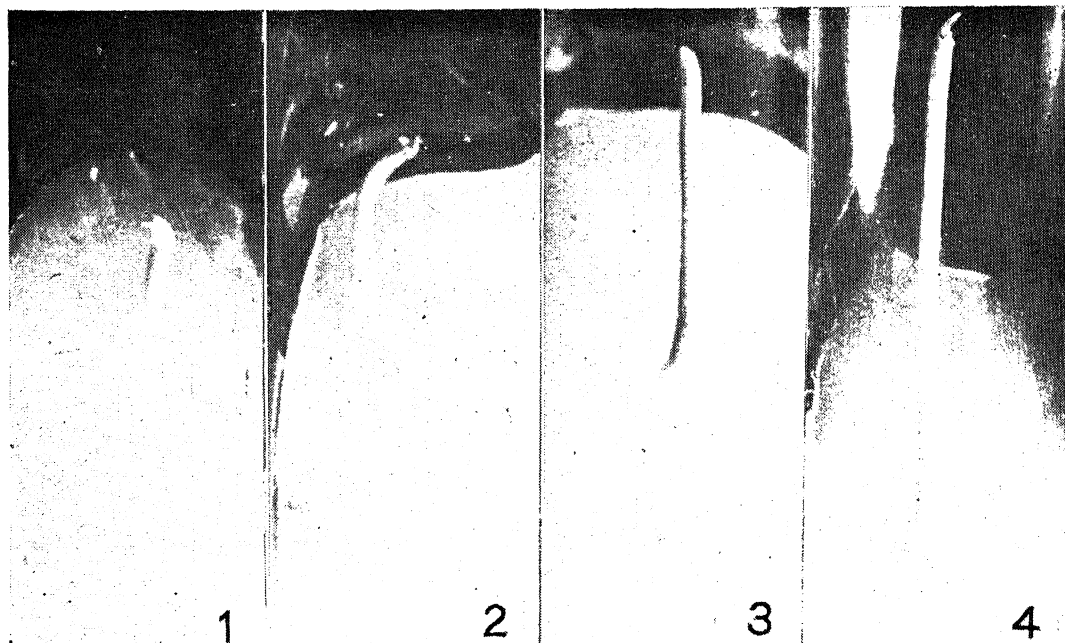
A majority of the cultured embryonal axes increased in size during the second day after inoculation. On the third day the root apical meristem was active and the tap root was evident on the following day. Elongation of the hypocotyl was noticed on the fourth day (Fig. 1). By this time the axis turned green.

Within a period of 15 days several secondary roots developed and ramified in the agar (Fig. 3). The terminal bud remained inactive upto 20 days.

In a second set of experiments the hypocotyl was isolated by a transverse cut below the cotyledonary node and planted on nutrient agar. In this case the course of development of the hypocotyl was similar to the one described for entire axes. Elongation was not affected by removal of apical bud (Fig. 3).

Normal plants were obtained from all the cultures of entire axes.

A curious feature observed during the growth of the hypocotyl was the curvature of its upper



FIGS. 1-4. *In vitro* culture of embryonal axis of *Clitoria ternatea*. Fig. 1. Axis after four days' growth. The root and the hypocotyl have elongated. Fig. 2. 6-day-old axis. Note the bending of the hypocotyl. Fig. 3. 15-day culture of hypocotyl devoid of apical bud. Note initiation of adventitious roots at the base. Fig. 4. 25-day-old culture of the axis. Note the developing epicotyl bud.

portion recalling the condition during natural germination. Even though there is no need for the cultured axes to 'pull out the cotyledons' the occurrence of curvature in the upper hypocotyl may be viewed as a gene-controlled phenomenon.

The course of growth of the axis is remarkably similar to the events of natural germination: 1. growth of root; 2. elongation of hypocotyl; 3. activation of shoot bud.

The results of this experimental study are comparable with the work on *Cajanus cajan* embryo segments (Kusum Kanta and Padmanabhan, 1964). It is evident from these experiments that embryonal organs are capable of independent development when isolated. However, the pattern and course of their development follow the same lines as in the entire embryo.

I am indebted to Prof. T. S. Sadasivan for facilities and encouragement.

University Botany Lab., D. PADMANABHAN.
Chepauk, Madras-5 (India).
October 28, 1965.

POLLEN MORPHOLOGY OF A NEW SPECIES OF *CUSCUTA*

POLLEN morphology of a new species of *Cuscuta*, namely, *C. santapauli* Banerji and Das¹ (in press) has been studied. Polliniferous material has been collected from Nepal and the pollen grains have been mounted in lactic acid.^{2,6} Terminology used for pollen description is after those of Nair.⁴ Pollen grains are 5-7-zonocolpate, spheroidal (equatorial diameter 30.4 μ ; range 28-32 μ). Apocolpium diameter is 13.6 μ . Exine is 3.2 μ thick; ectine thicker than endine, surface rugulate.

We have examined the specimen sheets of Wallich and Hooker, that have been referred by Yuncker⁷ to *C. reflexa* Roxb. Pollen grains from both the above materials have been found to measure 27.2 μ (range 24-29 μ) and the exine surface to be rugulate. Nair and Rehman⁵ give the pollen diameter in *C. reflexa* as 28 μ , and exine surface in the above and other Indian species, namely, *C. chinensis* and *C. planiflora* as reticulate. The exine in this new species—*C. santapauli*—is comparatively thicker.

It is noted that interspecific pollen differences exist within the genus *Cuscuta*. Erdtman² recorded the colpi number as 3-4 in *C. epilinum* and 3 in *lupuliformis*, while Nair and

1. Nitsch, J. P., *Amer. J. Bot.*, 1951, **38**, 566.

2. Kusum Kanta and Padmanabhan, D., *Curr. Sci.*, 1964, **33**, 704.

Planets for Man. By Stephen H. Dole and Isaac Asimov. (Methuen & Co. Ltd., Publishers, Ludgate Circus, 9855, 11, New Fetter Lane, London E.C. 4), 1965. Pp. x + 242. Price 25 sh. net.

In the course of millions of years the human species has adapted itself to the narrow ranges of temperature and air pressure, the availability of food and water, the chemical and physical components of our earthly environment. Now that the means are at hand for mankind to transcend this environment, the questions arise: Where else in the universe can such physical conditions be found? Does our medium-sized planet, circling a medium-sized star in the outer reaches of a typical spiral galaxy, have a counterpart among the countless heavenly bodies which surround it? What will men find as they gradually extend the range of their explorations? In speculating on some future consequences of manned space flight, this book looks forward to a time when human beings will be able to travel the vast distances to the other stars. It then attempts to determine—on the basis of our present biological and cosmological knowledge—whether there are other worlds where man can survive. C. V. R.

Statistical Theories of Spectra: Fluctuations. (Academic Press, New York and London), 1965. Pp. xv + 576. Price \$ 5.95; Clothbound Edition \$ 9.50.

This volume under review comprises a collection of fifty reprints and original papers and begins with an introductory article entitled "Fluctuations of Quantal Spectra" which covers the first 87 pages by the late C. E. Porter, who also appears elsewhere in the volume as author or joint author in eight other papers covering in all 126 pages. Nine other papers by E. P. Wigner in the aggregate cover 112 pages. Other authors who figure extensively in the collection are F. J. Dyson and M. L. Mehta who separately or jointly contribute ten papers covering an aggregate of 119 pages. The volume is concluded with an Appendix on Averages and Variances of Nuclear Cross-Sections covering 15 pages by R. G. Thomas. C. V. R.

The Upper Atmosphere Meteorology and Physics. (Vol. 8 of *International Geophysics Series*). By Richard A. Craig. (Academic Press, New York and London), 1965. Pp. xii + 509. Price \$ 12.00.

Designed for graduate students and research workers in meteorology, aeronomy, atmospheric

science, and for physicists, chemists, and astronomers interested in the upper atmosphere of the earth, this book emphasizes results and problems that pertain to composition, structure, and circulation of atmosphere between the tropopause and about 300 km. Most of the relevant observational material gathered during and since the International Geophysical Year is included and summarized. In addition, there is considerable reference to and discussion of some closely related physical, chemical, and astronomical problems. These include the solar ultra-violet spectrum, absorption by upper-atmospheric gases, ozone, infra-red transfer, atmospheric tides, geomagnetism, aurora and airglow and ionization phenomena. C. V. R.

Oriented Nuclei Polarized Targets and Beams (Volume 20 of Pure and Applied Physics). Edited by J. M. Daniels. (Academic Press, New York and London), 1965. Pp. xii + 278. Price \$ 9.00.

The purpose of this book is to present for the first time in one volume a concise account of nuclear orientation. Written as an introduction to the subject of angular effects, this book eschews mathematical detail and presents basic ideas. Only an elementary knowledge of quantum mechanics is required; calculations may be made without using Racah algebra. The subject in this volume is dealt with in seven chapters whose titles are as follows: I. Introduction; II. Thermal Equilibrium Methods of Orienting Nuclei; III. Non-thermal Equilibrium Methods of Nuclear Orientation; IV. Experimental Techniques for Nuclear Orientation; V. Beams of Polarized Particles from Nuclear Reactions; VI. Polarized Ion Sources for Accelerators; and VII. Experiments with Oriented Nuclei.

The book will be valuable to all research workers and graduate students in nuclear physics, magnetism, and related fields.

C. V. R.

Screening Methods in Pharmacology. By Robert A. Turner. (Academic Press, New York and London), 1965. Pp. xv + 332. Price \$ 12.00.

This book contains detailed descriptions of most of the modern methods used for the detection of pharmacological activity and modifications of older techniques used in the field. In addition, discussions on the organization of screening programs are included. Experimental procedures and their biological basis are

emphasized. New agents are compared with classical drugs, and quantitative comparisons by measured responses are given throughout.

The book follows a logical progression from the design of the experiment through the technical procedure, to the statistical evaluation of the results.

This work will be found useful by pharmacologists, physiologists, medical researchers, teachers and instructors in pharmacology, organic chemists, and laboratory technicians.

C. V. R.

International Review of Cytology (Vol. 18).

Edited by G. H. Bourne and J. F. Danielli. (Academic Press, New York and London), 1965. Pp. ix + 428. Price \$16.00.

Volumes 16 and 17 of this well-known series were reviewed in the issue of *Current Science* for May 20, 1965, Volume 34, page 306.

The present volume under review contains the following nine contributions by the authors shown against each: 1. The Cell of Langerhans, by A. S. Breathnach; 2. The Structure of the Mammalian Egg, by Robert Hadek; 3. Cytoplasmic Inclusions in Oogenesis, by M. D. L. Srivastava; 4. Tabulation of Enzymes in Subcellular Fractions, by D. B. Roodyn; 5. Histoenzymology by Substrate Film Methods, by R. Daoust; 6. Cytoplasmic Deoxyribonucleic Acid, by P. B. Gahan and J. Chayen; 7. Malignant Transformation of Cells *in vitro*, by Katherine K. Sanford; 8. Deuterium Isotope Effects in Cytology, by E. Flaumenhaft, S. Bose, H. L. Crespi and J. J. Katz; 9. The Use of Heavy Metal Salts as Electron Stains by C. Richard Zobel and Michael Beer.

C. V. R.

Human Chromosome Methodology. Edited by Jorge J. Yunis. (Academic Press, New York and London), 1965. Pp. xv + 258. Price \$8.50.

Recent advances in human cytogenetics have stimulated widespread interest among many investigators in the medical and biological sciences. As a direct result of this interest, a genuine need has been felt for an authoritative and up-to-date treatise which would serve as a text and reference. Readily comprehensible chapters are offered covering each phase of laboratory investigation from the preparation of materials for sex chromatin and chromosome techniques for bone marrow, blood, skin, and gonadal specimens to the subject of autoradiography and chromosome identification. Included also are guides to microscopy and microphotography as well as a thorough treatment of

chromosomes in disease. It is hoped that this volume will serve as an adequate guide to laboratory techniques and their applications for research workers, students of genetics, and members of the medical profession involved in setting up a laboratory of cytogenetics.

C. V. R.

Biochemistry of the Amino-Acids (Second Edition). By Alton Meister. (Academic Press, New York and London), 1965.

Volume I, Pp. xxvi + 592. Price \$22.00.

Volume II, Pp. xxiii + 492. Price \$20.00.

This revised and up-to-date treatise presents a comprehensive picture of the current status of amino-acid biochemistry—one of the most rapidly expanding fields in contemporary scientific research. Since publication of the first edition, many new amino-acids have been discovered and important advances have been made in our knowledge of the enzymes that catalyze the numerous reactions involved in amino-acid metabolism. The dramatic developments in the area of protein synthesis, such as the nucleic acid-amino-acid code, seem to be only a starting point for future investigations in biochemical genetics and the control of enzymatic activity.

Volume I contains information on the natural occurrence and properties of amino-acids and peptides, nutritional aspects of amino-acids, amino-acid antagonists, amino-acid transport, oxidative and non-oxidative deamination, amino-acid oxygenases, vitamin B₆ enzymes, and the synthesis of peptides and proteins.

Volume II is concerned with the biosynthesis and other aspects of the intermediary metabolism of the amino-acids, and with disorders of amino-acid metabolism in man.

Both volumes contain full references to the literature.

C. V. R.

Fish as Food. Edited by Georg Borgstrom. Volume 3, Processing—Part 1, Pp. 489. Price \$17.50.

Volume 4, Processing—Part 2, Pp. 518. Price \$18.50.

(Academic Press, New York and London), 1965.

The first two volumes of "Fish as Food" were reviewed in this journal in 1962 (Vol. 31, p. 172) and 1963 (Vol. 32, p. 526). According to the original plan the volume covering the general area 'Processing' was to have been the third and final volume in this work. However, the rich amount of information that has become available on the subject has necessitated the

division of the final volume into two volumes 3 and 4.

More than thirty authors representing an international cross-section of experts in the general field of handling and processing of fish and other aquatic catches have contributed to these two volumes. Topics covered in the third volume include drying and dehydration, smoking, salting of herring, marinades, anchovies and tidbits, fish sauces, pastes and sausages, whale products, fish solubles, and manufacture, properties and utilization of fish meal.

The majority of chapters in volume 4, are devoted to canning and preservation, and the topics dealt with include the following: Handling of fresh fish, Freshness tests, Tuna canning, Canning of sardine (Scandinavian and Maine), Brine refrigeration, Heat processing of shellfish, Squid meat, Fish and shellfish freezing, Processing at sea and factory ships. The potential advantages of radiation preservation, particularly the prospect of storing raw foods without refrigeration, have enthused interest among workers in the field of fish preservation, and there is a chapter which deals with this aspect of the problem giving some of the latest results.

The editor George Borgstrom, in collaboration with Clark D. Paris, has contributed to volume 3, a general article on "The Regional Development of Fisheries and Fish Processing" which surveys the present developments in fish processing industry in individual countries and regions.

The global problem of alleviating world hunger in the face of an explosive population calls for new methods of exploitation and maximum utility of available food resources of ocean waters, and to this effect this four-volume publication on "Fish as Food" will be particularly valuable to all those who are directly concerned in this problem. A. S. G.

Advances in Agricultural Sciences—Golden Jubilee Commemoration Volume of the "Madras Agricultural Journal". Edited by S. Krishnamurthi. (Issued by the Agricultural College and Research Institute, Coimbatore, India), 1965. Pp. 666.

The *Madras Agricultural Journal* was founded in 1911 and has a record of uninterrupted publication ever since. To mark the Golden Jubilee (50 years) of its publication, the

organizers decided to bring out a commemoration volume by inviting contributions from leading agricultural scientists in India and abroad, in the broad area of major advances in agricultural research. The manuscript which was released at a public function held to celebrate the occasion has now come out in print. It is a worthy volume and the Editor and his colleagues deserve the warmest congratulations from workers engaged in agricultural research in India.

The more than fifty articles contributed by more than sixty authors cover almost every field of agricultural research. Many of them are in the nature of review articles incorporating the latest developments in the subject and their applications; others are concerned with specific problems and give the results of original investigations. Besides the large number of Indian experts who have made contributions the list of authors includes well-known specialists from U.S.A., U.K., Japan, and the F.A.O.

The contributions are arranged under six chapters: The first chapter contains papers on Plant Breeding, Cytogenetics, Plant Physiology, and Plant Introduction. The second chapter contains papers on Agronomy, Meteorology, Soil Conservation, and Agricultural Economics. The third chapter deals with Soil Science. The fourth chapter is devoted to Horticulture under the three sections Fruits, Vegetables and Floriculture. The last two chapters are respectively on Plant Pathology and Entomology.

The volume which is a store-house of information on recent advances in agricultural science and their applications, should be welcomed not only by research workers but also by administrators and planners concerned with agricultural development in the country.

A. S. G.

Books Received

Annual Review of Biochemistry (Vol. 34). (Annual Reviews, Inc., 231 Grant Avenue, Palo Alto, California, U.S.A.), 1965. Pp. vii + 700. Price \$9.00.

Elements of Structural Geology. By E. S. Hills. (Asia Publishing House, Calicut Street, Ballard Estate, Bombay-1), 1965. Pp. xi + 483. (Price not given).

Atoms and Molecules Simply Explained—An Introduction to Chemical Phenomena and their Applications. By B. C. Saunders and R. E. D. Clark. (Dover Publications, 180, Varick Street, New York 14), 1965. Pp. v + 299. Price \$1.50.

THE NEW PHYSIOLOGY OF VISION

Chapter XXXVI. The Postulated Duality of the Retina

SIR C. V. RAMAN

THE facts of observation set out in the preceding chapter lead us to make a critical examination of the belief, firmly held by physiologists at the present time, that the human retina exhibits a duality in its structure as well as in its functioning. This belief finds concrete expression in the distinction drawn between two types of vision which are termed respectively as "photopic vision" and as "scotopic vision" and which are assumed to exist and to be distinguishable from each other. While "photopic vision" is effective at the higher levels of illumination, "scotopic vision", as its name indicates, functions at the lowest levels. "Photopic vision" alone exhibits differences of colour, while "scotopic vision" is achromatic. The acuity of vision is high in "photopic vision" and is almost non-existent in "scotopic vision". To give plausibility to these beliefs, it is suggested that "photopic vision" may be identified with "cone-vision" and "scotopic vision" with "rod-vision". So strongly are these beliefs entrenched in the literature of the subject that it may come as a surprise to the reader to be informed that the purpose of the present chapter is to demonstrate that the supposed duality of the human retina is a myth and that the ideas regarding human vision which rest on the assumption of such duality are altogether erroneous.

The Falsity of the Postulate.—We may begin by pointing out that the differences in the characteristics of human vision at high and at low levels of illumination which have been sought to be interpreted as a consequence of the rod-cone duality of the structure of the retina have in reality, an altogether different origin. It will suffice to point out that in all critical observations we naturally make use of the foveal regions of our retinae, and these regions, as is well known, contain only cones and no rods. Nevertheless, the fading away of colour and the loss of visual acuity which are associated with low levels of illumination are conspicuously evident in such observations. If, for example, the Great Nebula in Orion is viewed through a pair of binoculars, it appears as a luminous cloud without a trace of colour. On the other hand, seen through the great

telescopes of the world, it appears as a vast area exhibiting resplendent colours.

Elsewhere than in the fovea, the rods and cones appear interspersed in the retinal structure. It may therefore be taken for granted that the characteristics of human vision are determined by the rods and cones functioning jointly and not independently. Indeed, the assumption that rod-vision and cone-vision function independently of each other is ruled out by various facts of experience. We may here, for instance, recall the studies of the half-tone process of colour reproduction set out in an earlier chapter. It emerged from those studies that the retina integrates the different colours incident on it in adjacent areas and perceives them as a single resultant colour.

From the known fact of observation that fainter objects appear distinctly brighter when seen by averted vision than when viewed directly, we infer that the rods are more sensitive as detectors of radiation than the cones. This indeed becomes evident when a very faintly illuminated screen of plastic material which diffuses the light incident on it is viewed in a dark room. The marginal regions of the screen appear distinctly brighter than the central area. But the latter area continues to be perceived even at the lowest levels of illumination, thereby showing clearly that the fovea does not cease to function even in the dimmest light.

That the retina functions as a single unit and not as two retinae with different characteristics becomes even clearer when the observations set forth in the preceding chapter are recalled. An elongated slit backed by an extended source of light is viewed by the observer through a replica diffraction grating. Diffraction spectra having the same length as the illuminated slit are then seen in the field of view of the observer going right across the retina of the observing eye. When the luminosity of the source behind the slit is varied, the character of the spectra also alters. This is a demonstration that the so-called "luminous-efficiency" of radiation is itself dependent on the intensity of the light under observation. It alters progressively as

we proceed from high to low levels of illumination. What is particularly significant is that these changes are not observably different for the different parts of the retina on which the spectra fall with the arrangement described.

Very significant also, are the changes noticed and described in the preceding chapter in the character of the spectrum of white light as we proceed towards low levels of illumination. In succession, the red sector, the yellow sector and the blue sector of the spectrum pass out of sight, till, finally, only the green sector in the wavelength range between $560\text{ m}\mu$ and $500\text{ m}\mu$ survives. It is this part of the spectrum which enables us to perceive light at the very lowest levels of brightness. It is evident that these faintest observable spectra bear no resemblance to the "scotopic spectrum" which has been described as covering the entire range of wavelengths from $400\text{ m}\mu$ to $700\text{ m}\mu$ and as exhibiting the "maximum luminous efficiency" at the wavelength of $500\text{ m}\mu$ or thereabouts. The inference is that the "scotopic spectrum" is an artificial concept which has no real significance in relation to the facts of human vision. We are also justified in inferring that the "visual purple" which has an absorption spectrum extending over the entire wavelength range from $400\text{ m}\mu$ to $650\text{ m}\mu$ does not function as the visual pigment which enables us to perceive light at low levels of brightness.

We proceed now to describe the results of some further experimental studies designed to carry the investigation of the visual perception of light in the various parts of the spectrum down to the lowest levels of illumination.

Techniques of Study.—We shall begin with the description of an experimental arrangement which enables an observer directly to view a spectrum at levels of brightness which can be progressively altered from high values down to the lowest levels till we reach the threshold of human vision at which light ceases to be visible. The apparatus is essentially a prismatic spectrograph of substantial dimensions but with a rather small dispersive power. Special devices enable the brightness of the spectrum as perceived by an observer to be varied over a great range. The collimator is a telescope with a 3-inch objective which has a focal length of 4 feet; the eye-piece is removed and replaced by a spectrometer slit. The light from the collimator passes through a 30° prism of dense flint glass with a square face 3 inches in height and in breadth. The light dispersed by this prism enters the observing telescope which has an objective of

6 inches diameter and a focal length of 13 feet. Between the prism and this objective is placed an iris-diaphragm, the diameter of which can be progressively reduced from a maximum of 4 inches down to a minimum of $1/8$ th of an inch, thereby reducing the area of the opening to $1/1000$ th part of its maximum value.

The maximum brightness of the spectrum is obtained when the source of light is held close to the slit. By increasing the distance of the source from the slit, this brightness can be diminished. To obtain a further large step-down in intensity, the light from the source is first allowed to fall on a diffusing screen of milk-white plastic material, instead of falling directly on the slit. The light diffused by the screen then enters the slit of the spectrograph. Likewise, instead of the observer viewing the spectrum directly, a milkwhite plastic screen is placed at the focus of the 13-foot objective. The light reaches the screen and is focussed on it. The spectrum appearing on the screen is visible to the observer by reason of the light diffused backwards by the surface. Thereby results a large reduction of its observed luminosity.

The entire apparatus and the observer himself are located in a large room which could be completely darkened. The source of light and the diffusing screen which illuminates the slit are both placed in a covered passage which leads up to the observing room. But no light is permitted to enter that room except that passing through the slit and spectrograph. The complete spectrum when formed on the viewing screen is about 10 centimetres long and about 2.5 cm. broad. The observer remains in complete darkness for at least one hour before commencing his observations. He can view the spectrum either directly, or by averted vision if he so desires.

Observations with a Mercury Lamp.—It is useful in the first instance to make use of a source of light exhibiting the discrete lines of the mercury arc on the background of a continuous spectrum. Such a lamp being available, when it is placed directly against the slit, the mercury arc lines $\lambda 5790$ – 5770 , 5461 , 4916 , 4358 and 4046 can all be seen and recognised on the continuous background, provided the iris diaphragm between the prism and the objective is fully open. When the iris is progressively closed down, the luminosity of the entire spectrum falls off, but to quite different extents in its different parts. In particular, the continuous spectrum seen in the red sector becomes weaker

and finally disappears, the yellow doublet $\lambda 5790-5770$ becomes much fainter than the green line $\lambda 5461$, the continuous spectrum in the region of wavelengths less than $\lambda 5000$ ceases to be noticeable, $\lambda 4358$ becomes very weak and barely observable while the $\lambda 4046$ line completely disappears from sight.

If, instead of allowing the light from the lamp to fall directly on the slit, we use the diffusing screen as explained above, the brightness of the observed spectrum is greatly reduced. Even when the iris is fully open, all that can be seen of in the spectrum is the yellow doublet $\lambda 5790-5770$ and the green line $\lambda 5461$ of the mercury and a faint continuum covering the green sector of the spectrum upto about $\lambda 5000$. The yellow doublet is seen to be feebler than the green line. When the iris is closed down, the continuum disappears and both the yellow and green lines become very faint, the former much more so than the latter. Further reductions in the level of brightness may be effected by moving the lamp away from the diffusing screen. By increasing their separation from 15 cm. to 150 cm., we lower the brightness by a factor of 100. In the spectrum as then observed, only the $\lambda 5461$ line is seen even when the iris is fully open. When the iris is progressively closed down, this line falls off in brightness and finally disappears from sight.

Observations with a Source of White Light.—If instead of a lamp containing mercury vapour, we use a coiled-coil tungsten filament emitting light at a high temperature, its continuous spectrum is that of white light extending over the wave-length range from $700 m\mu$ to $400 m\mu$. The alterations in the appearance of this spectrum as seen by the observer at various levels of brightness can be followed, step by step, in the same manner as described above in the case of the mercury vapour lamp. The red sector of the spectrum, the yellow sector and the blue sector each becomes progressively weaker and finally disappears from sight. All that is left of the spectrum is then the green sector in the range of wavelengths between $560 m\mu$ and $500 m\mu$ with very feeble extensions on either side. These extensions also disappear until we are left only with a patch of light covering the green sector of the spectrum. The weakening and final disappearance from sight of this green sector is most conveniently produced by a progressive closing down of the iris diaphragm separating the prism and the

objective of 13-foot telescope. It is of interest to note that patch of spectrum when actually visible appears noticeably brighter when seen by averted vision than when directly viewed.

The Spectra of the Moonlit and Starlit Skies. A very convenient arrangement which enables an observer to view the spectrum of the faint light reaching the earth from various parts of the sky at night is for him to locate himself beneath the covered dome of an observatory of moderate size, e.g., one of 16-foot diameter. Seated on the floor of the observatory, in total darkness and holding a replica diffraction grating before his eye, he views the sky through the narrow opening, about an inch wide, left between the shutters which cover up the sky when the observatory is not in use. The diffraction spectra of the light entering the dome of the observatory through this narrow opening are seen projected against the inner surface of the dome as curved arcs of light on either side of the slit. They run parallel to each other and to the slit from end to end. The spectra of the first order are usually the brightest; one of them may be brighter than the other. It is noteworthy that the spectra exhibit the same features over the entire length traversing the field of view of the observer, irrespective of the particular point on which the latter fixes his vision.

The brightness of the spectra as seen by the observer naturally depends on the circumstances of the case. If the sky is clear and is lit up by the light of the full moon, the spectra are particularly conspicuous. But their features differ greatly from what would be seen in similar circumstances when the sunlit sky is observed. The width of the spectrum is much reduced and it can be readily ascertained with the aid of a comparison spectrum that the only part of it actually visible is confined to the wave-length range between $560 m\mu$ and $500 m\mu$, in other words, the green sector. The red, yellow and blue sectors of the spectra are absent. Except that the spectra are less brilliant, precisely the same features are exhibited when the sky is clear and the moon is not full and hence the illumination of the sky by scattered moonlight is feebler. Indeed, the observations show that even the moon is absent and the spectrum under observation is that due to starlight alone, that the spectrum exhibits the same features though, of course, it is much less bright.

C¹⁴ DATES, BANAS CULTURE AND THE ARYANS

D. P. AGRAWAL

Tata Institute of Fundamental Research, Colaba, Bombay-5

INTRODUCTION

RESULTS of archæological excavations in India during the past 15 years have come to show that the Dark Ages (the period between the end of the Harappans and the advent of Buddha) are no more that dark. With every new excavation, the data on the material traits of the protohistoric cultures have been accumulating, though without much interpretation. Synthesis of this data was impeded mainly due to lack of written records and absence of absolute chronologies.

With the operation of the C¹⁴ laboratory at the Tata Institute and the interest of a few other laboratories, a large number of C¹⁴ dates are available for the protohistoric period now. An attempt has been made here to synthesise the archæological data pertaining to the first half of the Dark Ages in the light of the available radiocarbon dates.

CHRONOLOGY OF THE IIND-IST MILLENNIA B.C.

Harappa Culture was assigned a maximum time-spread of ca. 2500-1500 B.C. mainly on the basis of archæological contacts discovered in some sort of datable contexts in west Asia. Wheeler (1964) in a recent review has again emphasised that "the Akkadian contacts (ca. 2300 B.C.) are the only well-fixed points". He further says that "now at last C¹⁴ dates are beginning to come in, and suggest that the ends of my tentative pre-C¹⁴ bracket should be retracted". In the absence of datable archæological evidence various conjectural dates were assigned to the Neolithic and Chalcolithic Cultures. The whole protohistoric chronology was very fluid and subject of controversies.

Radiocarbon dates of various archæological samples have been reported by us from time to time in this journal (Kusumgar *et al.*, 1963; Agrawal *et al.*, 1964a, 1964b, 1965a, 1965b). Harappan time-spread has been pinpointed to ca. 2300-1750 B.C. (Agrawal, 1964); the Chalcolithic Cultures show a post-Harappan spread of ca. 1750-1000 B.C. (Fig. 1); P.G. Ware seems to be covered by ca. 1000-400 B.C. bracket; N.B.P. Ware is confined to ca. 450-50 B.C. These are the outlines of a very consistent chronological framework that are emerging now as a result of an intensive radiocarbon dating of proto-

historic cultures (Fig. 2). Much of it is borne out by relative stratigraphy, wherever available. We will discuss below the bearing of this new knowledge on the Aryan problem.

ARYAN PROBLEM

It may be stated at the outset that the problem of Aryans in India is very complex and in the absence of any written records some subjective reasoning has to be resorted to in any attempt to synthesise the data. No final solution is at hand; but the clues towards it are unmistakable and significant.

Piggot has discerned two distinct waves of these folk migrations that came to India. He says, "It is in this context of folk migrations around 2000 B.C. and the subsequent few centuries, that we can set the end of the Baluchi villages and the Harappa cities, but there is evidence that a second wave of conquest or colonisation from the west left traces in Baluchistan nearly a thousand years later" (Piggot, 1961). He identified the first wave with the destroyers of Harappa. The second wave left its traces in the sites of Moghul Ghundai, Zangian-Jiwanri cemeteries. Banerji (1965) has traced the affinity of this wave with Sialk V A (Iran) and in India has connected it with P.G. Ware people of India who were claimed to be Aryans by Lal (1955).

Sharma (1960) has also shown on the basis of Indian linguistic, literary and archæological evidence that Aryans came in India in two major waves. Lallanji Gopal (1962-63) finds that the Aryans in the early Vedic period knew only "ayas" (copper) but not iron.

Malwa and Jorwe Cultures have been suggested to be connected with the Haihayas (Sankalia, 1958); their western affinities also have been indicated by him (Sankalia, 1963a). These being mainly central Indian cultures, they can represent only subsequent stages of Aryan colonisation.

A recognition of the two waves is essential to interpret the data available about the material cultures of the Dark Ages.

Some scholars had equated (H. Geldern, 1936) the Copper Hoard Culture of India with the Aryans. Recent research has made this equation untenable (Lal, 1951; Sharma, 1965).

CHALCOLITHIC CULTURES OF INDIA

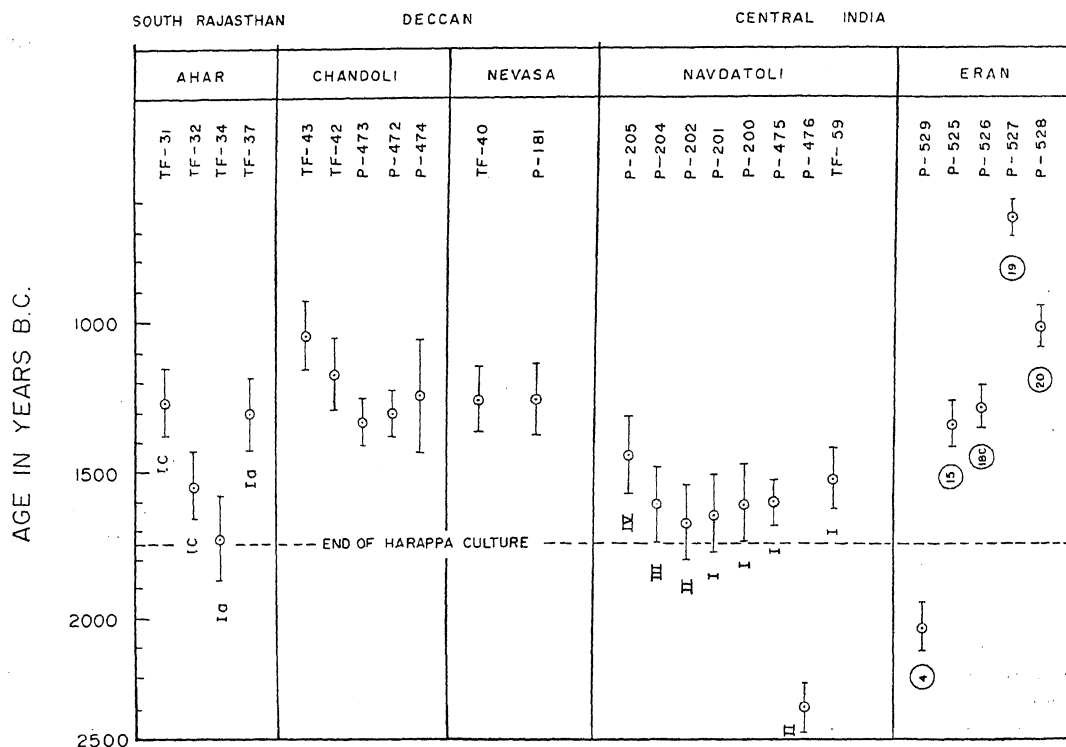


FIG. 1. Radiocarbon dates, based on $7 \frac{1}{2}$ 573 yrs., for post-Harappan Chalcolithic cultures.

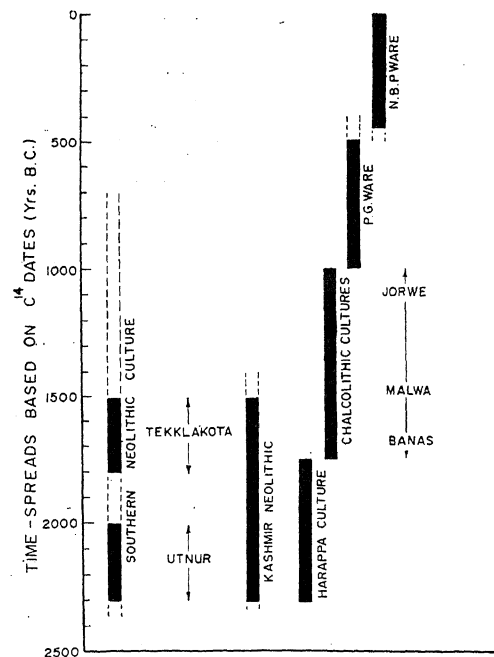


FIG. 2. Relative time-spread of Neolithic, Harappa, Chalcolithic, P. G. Ware and N. B. P. Ware Cultures.

BANAS CULTURE

Fig. 2 shows that Ahar's Copper Age (Banas) Culture emerges sometime in the XVIIIth century B.C., a time when Harappa Culture came to an end. The closeness of Banas Culture (types sites Gilund and Ahar) both in time and space to Harappans are a significant pointer to the probability of their contact. Now Desalpar excavations (Ghosh, 1963-64) have actually established this contact.

Gilund, which is a more promising site, yielded vast evidence for study of Banas Culture (Sankalia, 1963 b). Renewed excavations at Ahar too have revealed many new facets of this culture. Two strains in this culture are obvious: western Asiatic and Harappan. Cut-spouted vessels, strap handled jars, chandelier, bowl on a broad hollow stem and base have western affinities. Incised decorations on spindle whorls and animal headed handles have close parallels from Troy, Geoy Tepe and Anau. These traits probably point to the western territories traversed by these people. On the other hand, at Gilund we get dish-on-stands in black-on-

red, black-on-red wares, painted black-and-red ware ("Nilalohita"—blue and red—of Atharvaveda?) and polychrome ware: pottery traditions known to and practised by Harappans only so far. Moreover, burnt brick structures of huge size, terracotta bulls, gamesmen—all have Harappan affinity. Even the twin mounds of Gilund are reminiscent of Harappan cities. Inverted firing of pottery is a specialised technique and it is only reasonable to believe that Harappan potters were producing it. In all these industries the hand of the Harappan craftsman who was catering to the exotic tastes of the new masters seems to be unmistakable. These are significant pointers to the probability of the contacts of the Harappans and the Banasians. An intensive study of the available material and further excavations will undoubtedly throw more light on this contact.

Recent excavations at Desalpar are very enlightening in this connection. The cultural equipment of Period IB there can only be described as Banasian. In fact the Harappan traditions of Period IA continue to IB, but they are modified to suit some exotic tastes. The grey ware with bluish paintings of Period IA become little coarse and the designs become horizontal. The pottery traditions in Period IB suddenly multiply and we have an odd assortment of novel shapes and cream-slipped bichrome, grey painted black-and-red, white painted black-and-red wares. Such a heavy borrowing from the "vanquished" Harappans resulting in an eclectic assemblage is what one would expect of the nomadic Aryans. We know in Mitanni the Aryan chiefs "adopted the old equipment and organisation of Sumero-Akkadian-Babylonian civilisation... Hittites borrowed theology, law, poetry, and science as well as writing materials and characters from Mesopotamia. Still they modified what they borrowed to suit their own traditions and local needs" (Childe, 1954). Desalpar evidence when viewed from this angle establishes the contact between the Banasians and the Harappans. The sudden change in the tastes of people, despite basic continuity in the material culture, in Period IB can only be explained by the arrival of new people who, as they did not have a highly individualised material culture of their own, employed the existing craftsmen.

There is evidence of contact in the material culture, supported by a closeness in time which is unique. Geographical vicinity to the Harappans further fortifies it. If they (Banasians)

came from western Asia, as some of their pottery shows, and if they adopted Harappan traits, the circumstantial evidence becomes very strong that they themselves were responsible for the final collapse of the Harappans, though there may be other inherent reasons for the decline of the latter people (Dales, 1964). Affinities with Troy and Anau strengthen the circumstantial evidence for this Aryan equation. Banas Culture possibly represents the first attempts at settlement by these nomadic people in India.

P.G. WARE

Lal (1955) proposed that "P.G. Ware may be placed somewhere within the limits of 600 B.C. on the one hand and 1500 B.C. on the other" and equated it with Aryans. Hastinapur P. G. Ware however was dated by him to ca. pre-1100-800 B.C. Now C¹⁴ dates (Fig. 2) have firmly established a time gap of about 700 yrs. (ca. 1750-1000 B.C.) between P.G. Ware and the Harappans. This time gap is testified also by the stratigraphical hiatus between the Harappa and P.G. Ware deposits at all the excavated sites. Wheeler's (1959) words in this context seem prophetic: "It is possible to suppose that the P.G. Ware may represent the second phase of their (Aryans) invasion in India". P.G. Ware Culture is fully conversant with the use of iron. In their culture one does not get even the faint echo of Harappan contact.

Chronology, stratigraphy and the character of the P.G. Ware unmistakably prove that this culture is far removed from the Harappans. Summarising the results of the Rajasthan explorations, Ghosh said, about the Harappa and P.G. Ware Cultures, "the settlements of each originated, flourished and died out in its own time, entirely independently of the other" (Ghosh, 1952). Banerji (1965) has also convincingly shown 12th-11th century B.C. migrations to be responsible for the P.G. Ware Culture in India.

The discovery of black-and-red ware tradition in the Doab in pre-P.G. Ware horizon, in Bihar in pre-N.B.P. context and in Malwas and Deccan in the earliest levels, enhances the significance of Banas Culture. In fact, after a joint examination of the black-and-red wares of Gilund and Atranjikhhera (from pre-P.G. Ware levels) Lal and Gaur (private communication) feel that there is a genetic relationship between the two. In Kausambi again we get an echo of Harappan craftsmanship in the architecture (Sharma, 1960) of the period

associated with the black-and-red ware. If the spread of this early black-and-red ware represents the early colonisation by Aryans (this reminds one of the spread of Anus to the Eastern India and the Yadus to the Deccan) by this time they have become regular city dwellers!

CONCLUSIONS

Aryans did not have a developed uniform culture—they always travelled light and were liberal in borrowing from the other cultures. The variety of cultures that we get in the north-west India in the wake of Harappan collapse is what should be expected of the Aryans in this nomadic invading phase. Individualisation and uniformity in culture is a product of settlement and came to Aryans only when they started colonising.

The following facts raise a strong probability of equating Banasians with the early Aryans:

1. The closeness of Banas Culture, in time and space to the Harappans.
2. Banas Culture traits showing heavy borrowings from the Harappans.
3. A spread of black-and-red ware tradition in the Doab and Bihar in pre-P.G. Ware and pre-N.B.P. Ware contexts respectively.
4. P.G. Ware being a late intruder, it cannot be equated with the early Aryans. It is obvious that P.G. Ware covers only the latter part of Dark Ages in the North.
5. Folk migrations from western Asia in first centuries of the second millenium and the end of the Harappans by the middle of eighteenth century B.C. and finally the sudden emergence of Banas Culture about that time cannot be explained by any other hypothesis.

Aforementioned considerations make a full excavation of Gilund and other allied sites a

desideratum. The material culture should then be analysed from these new angles. Present paper only aims at emphasising some new angles in the study of the problem. At the present stage of our knowledge these conclusions seem inescapable; but only further comprehensive work—in the fields of archaeology, linguistics and ancient literature—will decide the issues finally.

1. Agrawal, D. P., *Science*, 1964, **143**, 950.
2. —, —, Kusumgar, Sheela and Sarna, R. P., *Curr. Sci.*, 1964a, **33**, 40.
3. —, —, —, —, —, *Ibid.*, 1964b, **33**, 266.
4. —, — and Kusumgar, Sheela, *Ibid.*, 1965a, **34**, 42.
5. —, —, —, — and Lal, D., *Ibid.*, 1965b, **34**, 394.
6. Banerji, N. R., in *Indian Prehistory*, 1964. Deccan College, Poona, 1965.
7. Childe, V. G., *What Happened in History*, Penguin, Baltimore, Md., 1954.
8. Dales, G. F., *Expedition*, 1964, **4**, 36.
9. Geldern, H., *Jour. of Ind. Soc. of Oriental Art*, 1936, **4**, 87.
10. Ghosh, A., *Bulletin of the National Inst. of Sciences*, 1952, **1**, 37.
11. —, —, *Indian Archaeology—A Review* (in press), 1963-64.
12. Kusumgar, S., Lal, D. and Sarna, R. P., *Proc. Ind. Acad. Sci.*, 1963, **58**, 141.
13. Lal, B. B., *Ancient India*, 1951, **7**, 20.
14. —, *Ibid.*, 1955, **10 & 11**, 5.
15. Lallanji Gopal, *Jour. of Andhra Hist. Res. Soc.*, 1962-63, **28**, 39.
16. Piggot, S., *Prehistoric India*, Penguin, Baltimore, Md., 1961.
17. Sankalia, H. D., *The Excavations at Maheshwar and Navdatoli, 1952-53*, Deccan College, Poona, 1958.
18. —, *Artibus Asiae*, 1963a, **26**, 312.
19. —, *Prehistory and Protohistory in India and Pakistan*, Univ. of Bombay, Bombay, 1963b.
20. Sharma, G. R., *The Excavations at Kausambi* (Univ. of Allahabad, Allahabad), 1960.
21. Sharma, Y. D., in *Indian Prehistory*, 1964, Deccan College, Poona, 1965.
22. Wheeler, R. E. M., *Early India and Pakistan*, Thames and Hudson, London, 1959.
23. —, *Antiquity*, 1964, **38**, 308.

THE WEALTH OF INDIA: INDUSTRIAL PRODUCTS—PART VI*

THE present volume of the Dictionary of Indian Industrial Products maintains the commendable features, both in contents and get-up, of the previous volumes. It contains articles dealing with 28 industries ranging from Heavy Machinery and Motor Vehicles to Pins, Clips and Staples. Each article gives valuable information on production, economics, trade, etc., supplemented by tables, text-figures and photoplates.

The volumes of the Dictionary of Industrial

Products together with the sister volumes on Raw Materials constitute a work of national importance in resurgent India and are indispensable for industrialists, entrepreneurs of small-scale industries, economists, and planners of Industrial India.

* *The Wealth of India: Industrial Products—Part VI*, Published by the Council of Scientific and Industrial Research, Publication and Information Directorate, C.S.I.R., Hillside Road, New Delhi-12, pp. xiv + 315 + xiv (Index).

VAPOUR-PHASE AROMATIZATION OF *n*-HEPTANE

N. SUBRAHMANYAM AND S. S. GHOSH

Department of Chemical Engineering, Indian Institute of Science, Bangalore

"AROMATIZATION", or otherwise known as "Dehydrocyclization", is a special process carried out in the refineries for upgrading the usefulness of light petroleum fractions by conversion of paraffins and olefins into aromatics. The reactions involved in the conversion of paraffins into aromatics may proceed along either of the paths as shown in the following scheme¹:

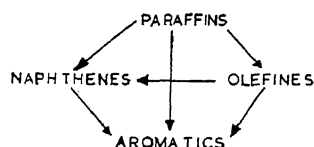


CHART A

A detailed thermodynamic analysis of a vapour-phase aromatization reaction of *n*-heptane at atmospheric pressure shows that, besides the main reaction of (1) conversion of *n*-heptane to toluene, the following side reactions might also proceed simultaneously under the reaction condition:

- (2) Simple dehydrogenation to heptene,
- (3) Complete breakdown into elemental carbon and hydrogen,
- (4) Cracking into lower hydrocarbons and
- (5) Partial dehydrocyclization to naphthene (methyl cyclohexane).

In the vapour-phase reaction conducted by us in a fixed-bed reactor over an aromatization catalyst it was observed that there was absolutely no formation of naphthene, so that our data could be interpreted on the basis of the following reactions:

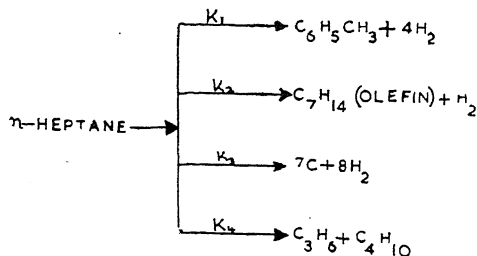


CHART B

Catalyst.—Of the various catalysts employed for the aromatization of paraffins, an Al_2O_3 - Cr_2O_3 composition is reported to be the most specific one where alumina, specially prepared

to give a large surface area, functions more as a catalyst support.² While for the high activity of synthetically prepared Al_2O_3 the required property is evidently a very large surface area, this in turn can be achieved by its preparation by a special method. In the present investigation, the catalyst support (Al_2O_3) was prepared by carbonation of potassium aluminate solution followed by thorough washing and ageing of the precipitated stuff. On granulation, drying and finally activating at an elevated temperature the stuff was found to possess a very high moisture adsorbing capacity (more than 40%). This evidently proved that the stuff possessed a large surface area, though the same has not been determined quantitatively by any of the known methods of surface area measurement.

Vapour-Phase Reaction and the Variables Studied.—The aromatization reaction was studied in the vapour-phase by conducting runs in a flow system of fixed-bed reactor at atmospheric pressure (680–685 mm.), the catalyst being Al_2O_3 - Cr_2O_3 of four different compositions and two different particle sizes (10 + 14 and 14 + 20 Tyler). The reaction temperature ranged between 500° and 600° C. and *n*-heptane feed rate maintained at 21 to 66 gm. per hour.

Product Distribution.—The product distribution pattern can be seen in Fig. 1 which

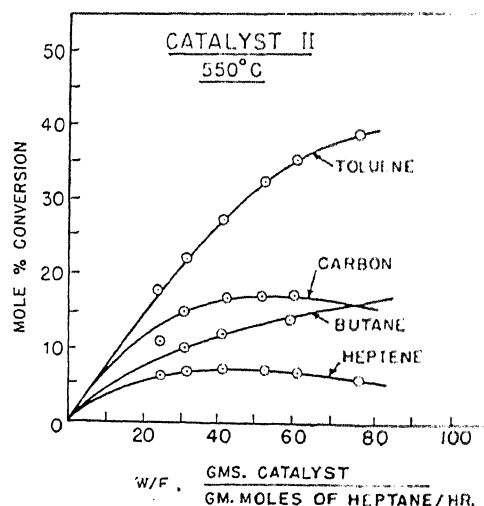


FIG. 1

represents a typical run conducted at 550° C. with a catalyst having the composition 30% Cr₂O₃ and 70% Al₂O₃ (Catalyst II), and of particle size -14+20. The analysis of the liquid product was done in accordance with recommended A.S.T.M. Standards: The analysis of the gaseous product shows that butane and propylene are its major constituents, so that the predominating cracking reaction can be taken as



The kinetic data, obtained by us, when tested by Hougen and Watson approach,⁴ indicated a dual-site mechanism for the aromatization reaction, the controlling step being the surface reaction; and single-site mechanism for the dehydrogenation reaction. This shows that our results are in good agreement with the Twigg's mechanism, though our approach is entirely different from his.

Authors' sincere thanks are due to Prof. N. R.

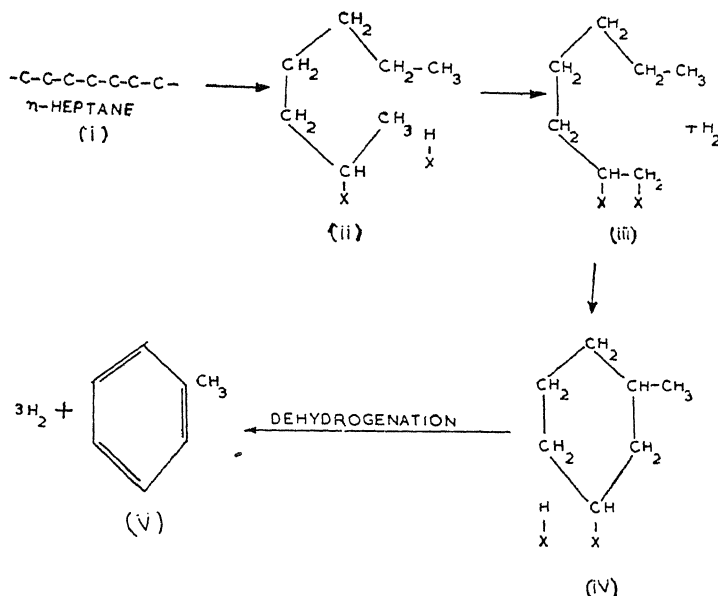


CHART C

Reaction Rates.—The following reaction rate constants for all the four reactions were obtained:

$k_1 = 2.9700$	gm. mols./gm. catalyst	\times	hr. ⁻¹
$k_2 = 0.1605$	"	"	"
$k_3 = 0.7000$	"	"	"
$k_4 = 1.2500$	"	"	"

Reaction Mechanism.—The widely accepted Twigg's³ mechanism for the aromatization reaction is as given in Chart C.

Kuloor for his keen interest in this investigation and to the C.S.I.R., New Delhi, for the award of a Research Fellowship to one of them (N. S.).

1. Hoog, H., Verheus, J. and Zuiderweg, F. J., *Trans. Farad. Soc.*, 1939, p. 993.
2. Pines, H., *et al.*, *Chemistry and Industry*, 1959, p. 1379.
3. Twigg, G. H., *Trans. Farad. Soc.*, 1939, **35**, 934.
4. Hougen, O. A. and Watson, K. M., *Chemical Process Principles*, Part III (Fifth Printing), John Wiley and Sons, 1955, p. 906.

LETTERS TO THE EDITOR

RELAXATION TIME AND ACTIVATION
ENERGY OF SOME HYDROXY
BENZOIC ACIDS

RELAXATION times of *ortho*-, *meta*- and *para*-hydroxy benzoic acids and 3, 5-dinitro benzoic acid have been determined in the 3 cm. microwave region at a temperature of 23.5° C., using dioxane as solvent. The relaxation times of hydroxy benzoic acids are found to decrease from *ortho* via *meta* to *para* compounds. It has been concluded that both molecular as well as intramolecular processes are responsible for dipole orientation. Potential barrier heights for dielectric relaxation and viscous flow have also been calculated.

Dipole moments of *meta* and *para* chloro and bromo benzoic acids have been determined by Brooks and Hobbs.¹ Wilson and Wenzke² have reported dipole moments of *p*-nitro benzoic acid. In the present investigation, the relaxation times and free energies of activation for *ortho*-, *meta*- and *para*-hydroxy benzoic acids and 3, 5-dinitro benzoic acid have been determined.

Relaxation times (τ) were determined from the fixed frequency method of Gopala Krishna³ for dilute solutions, discussed in an earlier paper.⁴ Standing wave technique of Von Hippel and Roberts⁵ was used. Potential barrier heights for dipole orientation and viscous flow have been determined using Eyring's⁶ relations and his estimated values of the constants A and B.

All the substances used were of the pure quality L. R. Grade and obtained from Messrs. B.D.H. light. Analar dioxane was distilled before use.

The values of relaxation time and of activation energy are reported in Table I.

TABLE I

Values of Relaxation time τ and free energies of activation for dielectric relaxation and viscous flow

Compounds	$\tau_{\text{expt.}} \times 10^{12}$ Sec.	H_{τ} (k. cal./ mole)	H_{η} (k. cal./ mole)	H_{η}/H_{τ}
<i>o</i> -Hydroxy benzoic acid in dioxane	11.10	2.49	3.30	1.32
<i>m</i> -Hydroxy benzoic acid in dioxane	10.79	2.48	3.30	1.33
<i>p</i> -Hydroxy benzoic acid in dioxane	9.96	2.43	3.30	1.36
3, 5-dinitro benzoic acid in dioxane	19.92	2.84	3.30	1.16

The observed small relaxation times of hydroxy benzoic acids, suggest that both molecular as well as intramolecular rotations are responsible for the process of dipole orientation.

It is found that the relaxation times of hydroxy benzoic acids decrease from *ortho*- via *meta*- to *para*-compounds. This can be explained from the fact that both substituted groups namely -COOH and -OH which are capable of rotating round their bonds with the ring mutually hinder their rotation, the hindrance decreasing as the two groups are more distant apart. The contribution of intramolecular rotation to the process of dielectric relaxation will be the least in the *ortho* and greatest in the *para*-compound, for the intramolecular hydrogen bonding between -OH and -COOH groups produces hindrance of rotation of the -COOH group more at the *ortho*-position.

Relaxation time of 3, 5-dinitro benzoic acid is found to be greater than hydroxy benzoic acids as expected from its larger size and also as it has only one polar group capable of rotation round its bond. However, the comparatively much higher relaxation time of 3, 5-dinitro benzoic acid indicates that inner friction experienced by it in rotation is also much higher than that experienced by a hydroxy benzoic acid molecule.

The values of free energy of activation for dipole orientation are found to decrease from *ortho*- via *meta*- to *para*-compounds, suggesting that barrier heights hindering the rotation of the molecules also decrease in the same order. The larger value of H_{τ} for 3, 5-dinitro benzoic acid can be expected to result from the greater inner friction experienced by a comparatively bigger molecule.

The values of free energy of activation for dielectric relaxation are found to be smaller than those for viscous flow, because the process of dipole orientation involves only rotation while the process of viscous flow involves both rotation and translation. Similar results have been recently observed by Ahmad and Sharma⁷ in the case of substituted toluenes.

Our thanks are due to Dr. P. N. Sharma for his encouragement and continued interest in the work.

Physics Department,
Lucknow University,
Lucknow, January 13, 1966.

N. K. MEHROTRA.
J. P. SHUKLA.
M. C. SAXENA.

1. Brooks, C. S. and Hobbs, M. E., *J. Am. Chem. Soc.*, 1940, **62**, 2851.
2. Wilson, C. J. and Wenzke, H. H., *Ibid.*, 1935, **57**, 1265.
3. Gopala Krishna, K. V., *Trans. Farad. Soc.*, 1957, **53**, 767.
4. Mehrotra, N. K., Shukla, J. P. and Saxena, M. C., sent for publication in the *Ind. J. Pure and Appl. Phys.*
5. Roberts, S. and Von Hippel, A., *J. Appl. Phys.*, 1946, **17**, 610.
6. Eyring, H., Glasstone, S. and Laidler, K. J., *The Theory of the Rate Process*, McGraw-Hill Co., New York, 1941, p. 548.
7. Ahmad, S. I. and Sharma, M. N., *Ind. J. Phys.*, 1965, **39**, 149.

CHEMICAL COMPONENTS OF *HELIOTROPIUM EICHWALDI*

SEVERAL species belonging to the genus *Heliotropium* (family Boraginaceae) have been examined chemically by various workers and found to contain alkaloids which are pyrrolizidine derivatives.¹ These are known as 'Senecio bases', since they were first obtained from *Senecio* species (family compositae).

Heliotropium eichwaldi is an annual plant with small white flowers growing in the plains of north-western India and in Kashmir upto an altitude of 5,000 ft. The plant is known to be poisonous to men and animals. It is emetic and is used in indigenous medicine as an antidote for snake bite by internal administration and local application. The leaves are employed in the treatment of ulcers and warts. A survey of the literature showed that the plant contained a toxic alkaloid of unknown nature.²

The plant grows wild in Delhi and was collected at the flowering season in August 1965. The whole air dried plant (800 g.) was extracted with hot ethanol and the extract concentrated to small bulk. On cooling a considerable quantity of crystalline material separated, and was identified to be potassium nitrate. The alcoholic filtrate was acidified with an equal volume of aq. 10% citric acid and the remaining ethanol was removed by distillation under reduced pressure. The aqueous acidic solution, after extraction with petroleum ether and ether to remove chlorophyll and waxy matter, was made alkaline with ammonia and extracted with chloroform in a continuous extractor. The chloroform solvent distilled under reduced pressure, when a brown gum (F_1) was obtained. It was fairly soluble in water and alcohol and

insoluble in petroleum ether, ether and benzene and gave an orange red precipitate with Dragendorff reagent. With Mayer's reagent it gave only opalescence. Its light yellow solution in acetic anhydride turned red on boiling. All attempts to crystallise the material as well as to prepare crystalline salts were unsuccessful. These properties and behaviour suggested that the base may be in the form of N-oxide. Hence the gum was dissolved in 2N sulphuric acid and reduced with zinc dust in order to obtain the tertiary amine, which could be more easily purified and studied. After the reduction the solution was made alkaline and extracted with chloroform. The chloroform extract yielded a light brown crystalline solid (F_2).

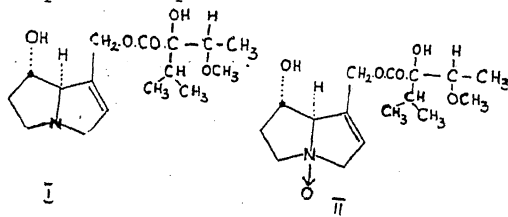
Paper chromatography (ascending and descending in three different solvent systems) of the alkaloid before and after the reduction shows that it is a single component. The spots were developed by spraying Dragendorff reagent. In ascending chromatography the N-oxide (F_1) has almost the same R_f values in all the three solvent systems, whereas the reduced base (F_2) possesses markedly high R_f value in the basic solvent system. This feature has been noted by earlier workers³ and confirms that the base (F_1) is an amine oxide.

TABLE I

Solvent systems	R_f values			
	Ascending		Descending	
	F_1	F_2	F_1	F_2
(i) <i>n</i> -Butanol : acetic acid : water (60 : 15 : 25)	0.62	0.69	0.59	0.73
(ii) <i>n</i> -Butanol : ammonia : water (30 : 1 : 5)	0.62	0.92	0.71	0.83
(iii) <i>n</i> -Butanol saturated with 5% acetic acid	0.59	0.64	0.60	0.78

The original aqueous alkaline solution, left after continuous extraction with chloroform, was made acidic with excess of 2N sulphuric acid and treated with zinc dust to reduce the chloroform insoluble N-oxide, if any. On working up the solution as described above some more crystalline solid was obtained which was found to be identical with the base (F_2). Total yield of the reduced base, 1.2 g. It could therefore be concluded that the aqueous solution retained the N-oxide which was not fully extracted by chloroform. The alkaloid (F_2) however crystallised from chloroform and petroleum-ether mixture as colourless needles, m.p. 124° C. The infra-red spectrum (in KBr) showed absorptions at 3400 (OH), 1730 (ester carbonyl), 1365 and 1380 cm^{-1} (isopropyl).

The base (F_1) on hydrogenolysis using Pd/CaCO₃ catalyst in absolute ethanol gave a neric acid and a necine. The acid crystallised from acetone-petroleum ether, m.p. 92° C. (Lit.³ m.p. for Heliotrinic acid, 94° C.) and the necine, which was liquid, yielded the picrate m.p. 192° C. (Lit.³ m.p. for desoxyheliotridine picrate 192–195°). This reaction along with the alkaline hydrolysis of the reduced alkaloid (F_2) to heliotridine and heliotrinic acid and the reoxidation of the alkaloid (F_2) to (F_1) indicate that the tertiary amine (F_2) is heliotrine (I). This was confirmed by direct comparison with an authentic sample of heliotrine (m.p. 124° C.) kindly supplied by Dr. J. R. Price and the m.m.p. was undepressed.



It is interesting that *H. eichwaldi* contains heliotrine completely in the form of its N-oxide (II). Earlier it was isolated along with its N-oxide from the seeds of *H. europæum*.³ Several other alkaloids belonging to this group are also known to occur along with their N-oxide in plants.¹ The proportion of the tertiary amine and the N-oxide varies depending upon the stage of the plant growth. It may be mentioned here that according to Areshkina the content of N-oxide reaches a maximum just before flowering and then falls with a corresponding increase of the tertiary amine base⁴; the results of the investigation of *H. eichwaldi*, which was collected just at the flowering season, is in accordance with this observation. The toxic nature of the *Senecio* bases and their N-oxides have been studied in detail on animals. The oxides possess toxicity more or less the same as the tertiary amines, since the former undergo reduction easily in the system.

Department of Chemistry, R. N. GANDHI.
University of Delhi, T. R. RAJAGOPALAN.
Delhi-7, December 2, 1965. T. R. SESHADRI.

GRAVIMETRIC DETERMINATION OF MOLYBDENUM (VI) IN PRESENCE OF TITANIUM AND ZIRCONIUM USING PURPUGOGALLIN

PURPUGOGALLIN has been used by the present authors¹ for gravimetric determination of molybdenum (VI) in the pH range 0.0–4.0. Molybdenum (VI) has also been estimated in presence of thorium, uranium, rare-earths and other cations in 1N hydrochloric acid medium. It was observed that titanium (IV) and zirconium (IV) get precipitated at the same acidity and thus interfere in the determination.

Following the earlier work, the precipitation of molybdenum was studied in presence of large quantities of fluoride, oxalate, tartrate and citrate ions. It was observed that the interference due to fluoride ions decreases with increasing pH values and at pH 3.5, 1% ammonium fluoride could be tolerated. It was, therefore, considered worthwhile to utilise this behaviour for the separation of molybdenum (VI) from other metal ions which form strong complexes with fluoride ions, e.g., zirconium and titanium.

A Metrohm pH-meter, model E-350, was used for measurement of pH. Purpugogallin was prepared by the method of Evans and Dehn.² Reagent grade chemicals were used for preparation of all solutions which were standardised gravimetrically.

TABLE I

Separation of molybdenum (VI) from zirconium and titanium using purpugogallin (1% in ethanol)

(Wt. of MoO₃ taken : 24.0 mg.)

Amount of TiO ₂ added (mg.)	Amount of ZrO ₂ added (mg.)	Amount of MoO ₃ found (mg.)	% error
5.0	5.0	24.0	0.0
10.0	10.0	24.0	0.0
20.0	20.0	24.0	0.0
30.0	30.0	24.6	2.4
30.0	..	24.0	0.0
40.0	..	24.0	0.0
50.0	..	24.4	1.7
..	30.0	24.4	1.7

Procedure for the Determination of Molybdenum in Presence of Zirconium and Titanium.—The pH of the aqueous solution containing titanium or zirconium and molybdenum was lowered to 1.0 with hydrochloric acid. Ammonium fluoride was added to the above solution to make it 0.5% with respect to fluoride ions and the solution was boiled to convert all zirconium and titanium completely into their stable fluoride complexes. The pH of the solution was

1. Rajagopalan, T. R. and Seshadri, T. R., *Curr. Sci.*, 1964, **33**, 163.
2. Glossary of Indian Medicinal Plants, Chopra, R. N., et al., *Council of Scientific and Industrial Research, New Delhi*, 1956, 131.
3. Culvenor, C. C. J., Drummond, L. J. and Price, J. R., *Aust. J. Chem.*, 1954, **7**, 277.
4. Areshkina, L. Ya., *Doklady Akad. Nauk, S.S.S.R.*, 1948, **61**, 483.

then raised to 3.5 with ammonia and excess of purpurogallin in ethanol (1%) was added to this solution. The solution was boiled for 10-15 minutes to remove all ethanol when molybdenum was completely precipitated and then kept aside for 1-2 hours. The precipitate was filtered through a Whatman (No. 42) filter-paper and washed with a solution of pH 3.5 containing reagent (0.1%), ammonium fluoride and ammonium nitrate. The precipitate was finally washed with ammonium nitrate solution of pH 3.5 and ignited to oxide at 500-550°C. as molybdenum trioxide volatilizes at higher temperatures. The results in Table I show that molybdenum can be separated from an approximately equal amount of zirconium and twice its weight of titanium.

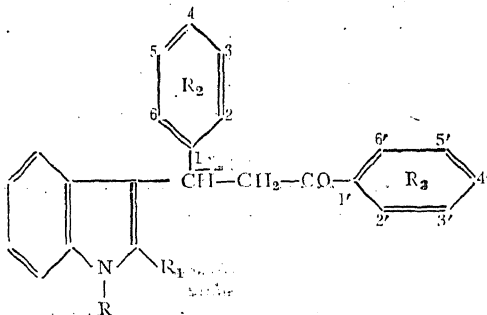
The authors are thankful to Prof. T. R. Seshadri, F.R.S., for his help and encouragement. Department of Chemistry, YAG DUTT.
University of Delhi, R. P. SINGH.
Delhi, November 5, 1965.

1. Dutt, Y. and Singh, R. P., *Ind. J. Appl. Chem.*, 1963, 26, 77.
2. Evans, T. W. and Dehn, W. M., *Amer. Chem. Soc.*, 1930, 52, 3647.

HETEROCYCLIC COMPOUNDS (X): REACTION OF INDOLES WITH CHALCONES

IN our previous communications we have reported the condensation of indole derivatives with dienophiles, such as β -nitrostyrenes¹ and methyl vinyl ketone² to form adducts. In connection with another project, we investigated the reaction of indoles with chalcones. The present communication describes for the first time reactions of indole, 2-methylindole, 2-phenylindole and N-methylindole with different chalcones to yield compounds (Table I) of the general structure given below.

TABLE I



No.	R	R ₁	R ₂	R ₃	Mol. Formula	m.p. (°)	Carbon %		Hydrogen %	
							Found	Required	Found	Required
I*	H	H	..	..	C ₂₃ H ₁₉ NO	140	84.8	84.9	5.4	5.8
II†	H	H	4-MeO	..	C ₂₄ H ₂₁ NO ₂	162	81.1	81.1	5.8	5.9
III	H	H	2-CH ₃	4'-CH ₃	C ₂₅ H ₂₃ NO	164	84.7	84.9	6.7	6.5
IV	H	H	4-MeO	4'-MeO	C ₂₅ H ₂₃ NO ₃	155	77.9	77.9	6.3	5.9
V	H	CH ₃	2-CH ₃	4'-CH ₃	C ₂₆ H ₂₅ NO	137	85.1	85.0	6.7	6.8
VI	H	CH ₃	4-MeO	4'-CH ₃	C ₂₆ H ₂₅ NO ₂	163	81.8	81.4	6.9	6.5
VII	H	CH ₃	4-MeO	4'-MeO	C ₂₆ H ₂₅ NO ₃	172	78.2	78.2	6.6	6.2
VIII	CH ₃	H	..	..	C ₂₄ H ₂₁ NO	175	84.9	84.9	6.5	6.2
IX‡	CH ₃	H	4-MeO	..	C ₂₅ H ₂₃ NO ₂	130-131	81.2	81.2	5.9	6.2
X	CH ₃	H	2-CH ₃	4'-CH ₃	C ₂₆ H ₂₅ NO	171	84.9	85.0	6.8	6.8
XI	CH ₃	H	4-MeO	4'-CH ₃	C ₂₆ H ₂₅ NO ₂	158	81.2	81.4	6.5	6.5
XII	CH ₃	H	4-MeO	4'-MeO	C ₂₆ H ₂₅ NO ₃	168	75.5	78.2	6.5	6.2
XIII	H	C ₆ H ₅	2-CH ₃	4'-CH ₃	C ₃₁ H ₂₇ NO	213	86.3	86.7	6.2	6.29
XIV	H	C ₆ H ₅	4-MeO	4'-CH ₃	C ₃₁ H ₂₇ NO ₂	186	83.3	83.59	6.5	6.07

* 2, 4-DNP (crystallised from acetic acid), m.p. 226-227° (N, Found 14.2%; required 13.9%).

† 2, 4-DNP (do.), m.p. 218° (N, Found 12.9%; required 12.7%).

‡ 2, 4-DNP (do.), m.p. 193° (N, Found 13.0%; required 12.7%).

The reaction was usually carried out by heating equimolecular quantities of the components together in the presence of a mixture of acetic acid and acetic anhydride. The yields varied from 10 to 65%. In some cases the adducts were characterised by the preparation of 2,4-dinitrophenylhydrazones.

Organic Chemistry Dept., J. R. MERCHANT.

Institute of Science, S. S. SALGAR.

Bombay-1, K. M. CHHATRIWALLA.

November 4, 1965.

1. Salgar, S. S. and Merchant, J. R., *J. prakt. Chem.*, 1961, **14**, 108.
2. Merchant, J. R. and Salgar, S. S., *J. Ind. Chem. Soc.*, 1963, **40**, 83.

AMINO-ACIDS OF LOBARIA SUBSIDIOSA, UMBILICARIA PUSTULATA, PARMELIA NEPALENSIS AND RAMALINA SINENSIS

IN continuation of our earlier work on the amino-acid composition of Indian lichens¹⁻³ we have examined *Lobaria subsidiosa*, *Umbilicaria pustulata* and *Parmelia nepalensis* from the Himalayan ranges and *Ramalina sinensis* from the Nilgiris for their amino-acids (both free and combined) and our results are given in brief in Table I.

TABLE I

Amino-acid composition of *Lobaria subsidiosa*, *Umbilicaria pustulata*, *Parmelia nepalensis* and *Ramalina sinensis*

Sl. No.	Amino acids	<i>Lobaria subsidiosa</i>		<i>Umbilicaria pustulata</i>		<i>Parmelia nepalensis</i>		<i>Ramalina sinensis</i>	
		Free*	Combined†	Free*	Combined†	Free*	Combined†	Free*	Combined†
1	Alanine	..	+	3+	2+	2+	3+	+	2+
2	Arginine	..	..	+	2+	..	2+	..	+
3	Aspartic acid	..	..	3+	..	2+	3+	..	2+
4	Glutamic acid	..	..	3+	+	2+	2+	..	+
5	Glycine	..	+	2+	+	2+	2+	..	2+
6	Histidine	..	..	+	..	..	..	..	..
7	Isoleucine	..	..	2+	2+	+	2+	..	+
8	Leucine	..	+	2+	2+	+	3+	..	+
9	Lysine	..	..	2+	+	..	2+	..	+
10	Methionine	..	+	2+	2+	+	3+	..	+
11	Phenyl alanine	..	..	2+	+	..	+	..	..
12	Proline	..	..	+	..	..	..	..	..
13	Serine	..	..	2+	..	2+	2+	..	+
14	Threonine	..	+	3+	+	..	2+	..	+
15	Tryptophan	..	..	Trace	..	Trace	Trace	..	Trace
16	Tyrosine	..	..	2+	..	Trace	+	+	Trace
17	Valine	..	..	+	..	Trace	+	..	..
18	Unidentified ²	..	..	+	..	+	+	..	+

* Each + indicates about 3 mg.% of the dry lichen.

† Each + indicates about 200 mg.% of the dry lichen.

Lobaria subsidiosa (Asah.) growing on pine trees in the Ganghariya area (alt. 10,000 ft.) has been found to contain about 7.8% of protein (Kjeldahl) as compared to a high value of about 22% in *Lobaria isidiosa*, and in its amino-acid composition it resembles *L. isidiosa* in having almost a similar pattern so far as the combined amino-acids are concerned, but lacks glutamic acid, serine, tryptophan, tyrosine and valine in the free state. *L. isidiosa* does not contain any free glycine and methionine which are present in *L. subsidiosa*. It may be mentioned here that *Lobaria* lichens have been recorded⁴ as useful for lung troubles and in the cure of eczema.

Umbilicaria pustulata (L.) Hoffm. growing on rocks in the Basudhara area (alt. 11,500 ft.) has been found to contain about 6.8% of protein and no histidine, either free or combined. *Parmelia nepalensis* (Tayl.) from the Joshimath area (alt. 7,500 ft.) contains 7.6% of protein with a characteristic predominance of free amino-acids when compared with *Parmelia tinctorum* reported earlier.^{1,3} *Ramalina sinensis* growing on trees in the Nilgiris in South India contains 7.5% of protein with a characteristic absence of free amino-acids except alanine and tyrosine. As a member of the *Usneaceae* family, it resembles other *Usnea* lichens in the combined amino-acid pattern reported earlier.¹

In recent years, chemical plant-taxonomy⁵ (biochemical systematics⁶) has assumed great significance, and in the classification of lichens the concept of chemical strains mainly based on the 'so-called' lichen acids has been adopted. In a recent and elegant review, Haynes⁷ has discussed the rationale of chemical strains in lichens, and it is now suggested that the amino-acid pattern should also be taken into account for a more fundamental basis of taxonomy of lichens, especially when morphologically indistinguishable individuals containing closely related lichen acids are met with. The importance of amino-acid patterns in direct taxonomic utility has been illustrated in the grouping of *Lathyrus* species⁸ and among *Cassia* and *Vicia* species.⁹⁻¹⁰ It may also be quoted¹¹ here that it is always dangerous to draw taxonomic conclusions from the occurrence or non-occurrence of a single compound in a plant.

We thank Prof. T. R. Seshadri, F.R.S., for his kind interest in this work and the samples of lichens, and Principal Dr. D. J. Reddy for encouragement.

S. RAMAKRISHNAN.

S. SANKARA SUBRAMANIAN.

Jawaharlal Institute of
Postgraduate Medical
Education and Research,
Pondicherry-6, October 8, 1965.

SOME INVESTIGATIONS ON THE OXALATE STATUS OF PUSA GIANT NAPIER GRASS AND ITS PARENTS

THE development of Pusa Giant Napier grass (PGN), a hybrid between 'Bajra' (*P. typhoides*) and Napier or Elephant grass (*P. purpureum*), at the Indian Agricultural Research Institute, New Delhi, could be considered as a major breakthrough in fodder production. With high yields of 2,500-3,000 quintals/hectare/year of green matter under irrigated conditions, it has established itself throughout the country. Nutritionally, also, it is superior and contains 25% and 12% more of protein and sugars respectively than Napier grass. It is less fibrous, juicy and palatable.¹ Besides, it promises to yield green fodder all the year round, of course, with an intercrop of Pusa Giant berseem in Northern India where it goes dormant during the winter months.²

The oxalate content of grasses is of great importance, as it is known to be highly toxic to grazing animals. The occurrence of carbonate calculi in the urinary tract of cattle ingesting such grasses, is associated with high oxalic acid. There were certain apprehensions prevailing in some quarters that the PGN has a high oxalate content and as such was not a very suitable fodder. The present investigations were, therefore, undertaken to obtain information on this aspect.

Samples of PGN at three stages of growth and those of its two parents (Bajra and Napier) were collected from the fields of the Botany Division of the Institute. Whole plants were chopped into fine pieces, dried in the oven overnight, and powdered in a coffee grinder. These were then analysed for their water-soluble and total oxalate content by Moir's³ titrimetric adaptation of Myer's⁴ method. Results obtained are presented in Table I.

From the results presented, it could be seen that the samples of Napier grass showed the highest oxalate content followed by PGN and Bajra. The oxalate content of 2.42% present in PGN of medium stage at which it is generally cut and fed to the cattle, may be considered of medium low value as far as toxicity to animals is concerned. According to Moir,¹ grasses containing 4% and above of oxalate may be considered toxic or even fatal to the cattle when these are grazed heavily on such grasses particularly under conditions of starvation, etc.

The water-soluble oxalate content shows the same trend as the total oxalate. This fraction is in fact the one that is most important from the toxicity point of view in animal feeding

1. Ramakrishnan, S. and Subramanian, S. S., *Ind. J. Chem.*, 1964, 2, 467.
2. Subramanian, S. S. and Ramakrishnan, S., *Curr. Sci.*, 1964, 33, 522.
3. Ramakrishnan, S. and Subramanian, S. S., *Ibid.*, 1965, 34, 345.
4. Rao, P. S., Sarma, K. G. and Seshadri, T. R., *Ibid.*, 1965, 34, 9.
5. Swain, T. (Ed.), *Chemical Plant Taxonomy*, Academic Press, London, 1963.
6. Alston, R. E. and Turner, B. L., *Biochemical Systematics*, Prentice-Hall, New Jersey, 1963.
7. Haynes, F. N., In *View Points in Biology*, Ed. Carthy, J. D. and Duddington, C. L., Butterworths, London, 1964, 3, 64.
8. Bell, E. A., *Biochem. J.*, 1962, 83, 225.
9. Alston, R. E. and Irwin, H. S., *Amer. J. Bot.*, 1961, 48, 35.
10. Bell, E. A. and Tirimanna, A. S. L., *Biochem. J.*, 1965, 97, 104.
11. Erdtman, H., in *Chemistry of Natural Products*, International Symposium of I.U.P.A.C., Prague, 1962, Butterworths, London, 1963, p. 683.

TABLE I
Oxalic acid content of Pusa Giant Napier grass and its parents

Crop	Moisture (%)	Oxalic acid (%) (on moisture-free basis)		Water-soluble oxalate as percent of total oxalic acid
		Water-soluble	Total	
1. Pusa Giant Napier (Tender)*	77	2.33 ± 0.062	3.04 ± 0.0282	76.6
2. Pusa Giant Napier (Medium)†	76.4	2.17 ± 0.040	2.42 ± 0.0919	89.6
3. Pusa Giant Napier (Ripe)‡	65.0	0.25 ± 0.0071	1.32 ± 0.0636	18.9
4. Napier grass sample 1 (Medium)*	69.0	2.61 ± 0.0258	3.31 ± 0.0636	78.8
5. Napier grass sample 2 (Medium)*	71.0	2.44 ± 0.0647	3.57 ± 0.0636	68.3
6. Bajra sample 1 (Medium)*	75.5	1.35 ± 0.023	2.295 ± 0.0183	58.8
7. Bajra sample 2 (Medium)*	72.3	0.34 ± 0.0087	1.54 ± 0.0232	22.07

* One month old.

† Two months old.

‡ Twelve months old.

(see Talapatra *et al.*⁵). On the basis of the results of chemical analysis, it could safely be concluded that the levels of oxalate present in PGN are quite low to produce deleterious effects of any kind on the health of the ingesting animals even when fed large quantities of the grass. The only evidence available, in support of the conclusion drawn, is that no report of abnormality of any kind, caused by ingesting this grass among animals, has so far been reported from any part of the country. However, final confirmation can only be done by carrying out carefully planned animal feeding and metabolic experiments.

The water-soluble fraction both in PGN (medium, tender) and Napier grass samples constitutes over 70% of the total oxalate present. In Bajra, however, it is much lower. Considering the values of total and water-soluble oxalate and the water-soluble fraction as percent of the total oxalate, it appears that the oxalate level in PGN is derived mainly from the Napier grass parent. Such a situation may be expected in view of the fact that the PGN is an allotriploid hybrid involving two genomes from the Napier grass parent and one from the Bajra parent.

The age of the PGN appears to exercise a profound influence on its oxalate status. There is a sharp fall both in the water-soluble and total oxalate content from the tender (one month old) to the ripe (about 12 month) PGN plants so much so that the water-soluble oxalate content of the ripe plants has become quite negligible. It should, thus, be possible to have plants of even lower oxalate content than those of PGN (medium age) depending on their age.

These and other investigations are now in progress.

The authors are grateful to Dr. M. S. Swaminathan, Head of the Division of Botany of this Institute, for his keen interest and encouragement and to Shri K. C. Sikka, Assistant Biochemist, and (Miss) S. Singh, Senior Research Assistant, Botany Division, for technical assistance during the course of these investigations.

Biochemistry Laboratory,
Division of Botany,
I.A.R.I., New Delhi-12,
September 8, 1965.

B. M. LAL.
R. P. JOHARI.
R. K. MEHTA.

1. Patil, B. D. and Joshi, A. B., *Ind. Farming*, 1962, 12 (6), 7.
2. Mehta, R. K. and Singh, A., *Ind. J. Agri. Sci.*, 1965 (In press).
3. Moir, K. W., Queensland, *J. Agric. Sci.*, 1953, 10, 1.
4. Myer, A. T., *J. Agr. Res.*, 1947, 74, 33.
5. Talapatra, S. K., Ray, S. C. and Sen, K. C., *J. Agric. Sci.*, 1948, 38, 163.

SODIUM CHLORIDE TOLERANCE BY *AZOTOBACTER CHROOCOCCUM*

Azotobacter has been known to be resistant to the action of high concentration of salts. As early as 1907, Keutner⁸ observed that marine *Azotobacter* could grow and fix nitrogen in 8% sodium chloride solution. Such reports on salt tolerance by *Azotobacter* are not wanting in literature.^{2,3,5,10,13} Inhibitory effects of salinity on nitrogen fixation by *Azotobacter* have been found by a few workers.^{4,6,9,11} However, we are not aware of the critical levels of a typical salt such as sodium chloride on

nitrogen-fixing ability of the bacterium. With this objective, the effect of increasing concentration of sodium chloride on nitrogen fixation by four strains of *Azotobacter chroococcum* was studied and the results are reported hereunder.

Jensen's liquid medium⁷ was used as substrate for growing the organism and the 0.05% sodium chloride contained in it was taken as the control. Twenty-five ml. aliquots of the sterilized medium in triplicate were inoculated separately with four strains of *A. chroococcum* from Delhi, Samalkot, Cuttack and U.S.S.R. The concentrations of NaCl tried were 0.05% (control), 0.10%, 0.20%, 0.30%, 0.50%, 0.80%, 1.00%, 1.50%, 2.00%, 2.50%, 3.00% and 5.00%. The cultures were incubated at 32° C. for 14 days at the end of which nitrogen was estimated by micro-Kjeldahl method.¹ It was evident from the results (Table I) that there was gradual

nitrogen fixed took place at 1.5% level of sodium chloride, while such a decrease occurred at 1.0% in U.S.S.R. strain, at 2.5% in Samalkot strain and at 2.0% in the Cuttack strain. These results appear important in selecting strains for use in saline soils of India for maximising nitrogen content of soils through non-symbiotic nitrogen fixation. The concentration of salts in Indian soils sometime goes upto 1 to 1.5%.¹² From the laboratory results obtained on salt tolerance by *A. chroococcum*, it is obvious that the Samalkot and Cuttack strains have possible potentialities for introduction into our saline soils since the strains retain a capacity to fix 65-80% of nitrogen even under 1.5% concentration of sodium chloride.

The authors are grateful to Mr. A. G. Kavitar for help in the statistical analysis of the data.

Division of Microbiology, V. ISWARAN.

Indian Agricultural N. S. SUBBA-RAO.

Research Institute, W. V. B. SUNDARA RAO.
New Delhi, October 15, 1965.

TABLE I
Nitrogen fixation by *A. chroococcum* in relation to increasing concentrations of NaCl (Average of three replicates in mg./g. sucrose oxidised)

% NaCl	Delhi strain	U.S.S.R. strain	Samalkot strain	Cuttack strain
0.05	11.39	14.15	16.61	17.36
0.10	12.13	14.00	16.24	17.28
0.20	8.21	11.22	15.96	16.05
0.30	7.28	7.13	16.05	15.68
0.50	7.28	7.28	14.09	14.52
0.80	6.35	6.57	14.00	13.81
1.00	6.35	7.09	14.19	11.94
1.50	5.79	6.91	13.63	11.76
2.00	5.60	5.23	11.57	8.96
2.50	5.60	5.24	8.96	5.23
3.00	5.23	Nil	5.23	Nil
5.00	Nil	Nil	Nil	Nil
	C.D. at 1% 1.16	C.D. at 1% 0.85	C.D. at 1% 1.35	C.D. at 1% 3.06

decrease in the amount of nitrogen fixed by all the strains as the concentration of sodium chloride increased; significant decrease in nitrogen fixation occurred at 0.8% NaCl in Cuttack strain, at 0.5% in Samalkot strain, at 0.2% of the salt in Delhi and U.S.S.R. strains. However, maximum limit of tolerance to the salt varied with the strains, the Delhi and Samalkot strains tolerated up to 3.0% sodium chloride while the U.S.S.R. and Cuttack ones did so up to 2.50%. In the control series, where 0.05% of sodium chloride was present in the substrate, the Cuttack strain of *A. chroococcum* fixed maximum amount of nitrogen. However, a 50% fall in the nitrogen-fixing activities of different strains occurred at varying doses of the salt depending on the strain used. In the Delhi strain, the 50% fall in the amount of

1. A.O.A.C., 1955, p. 805.
2. Barnes, J. H. and Ali, B., *Agric. J. Ind.*, 1917, **12**, 368.
3. Blinkov, G. N., *Mikrobiologiyz*, 1962, **31**, 880.
4. Greaves, J. E., Carter, E. G. and Lund, Y., *Soil Sci.*, 1922, **13**, 481.
5. — and Jones, L. W., *Ibid.*, 1941, **52**, 359.
6. Iswaran, V. and Sen, A., *Jour. Ind. Soc. Soil Sci.*, 1958, **6**, 109.
7. Jensen, H. L., *Proc. Soc. Appl. Bact.*, 1951, **14**, 89.
8. Keutner, N., *Exp. Sta. Rev.*, 1907, **17**, 118.
9. Lipman, C. B. and Sharp, L. T., *Centbl. Bakt. Abt.*, 1912, **32** (ii), 647.
10. Mickovski, M., *Ann. Fac. Agric. Skopje*, 1961, **14**, 277.
11. Mockeridge, F. A., *Ann. Bot.*, 1912, **26**, 871.
12. Raychaudhuri, S. P., et al., *Soils of India*, I.C.A.R. Publication, 1963.
13. Sushkina, N. N., *Mikrobiologiya*, 1956, **25**, 35.

GREEN GARNET FROM THE BANDITE SERIES, BANDIHALLI, TUMKUR DISTRICT, MYSORE STATE

THE garnet (uvarovite)-diopside-granulite occurring near the village Bandihalli (Lat. 12° 47'; Long. 77° 1'), Tumkur District, Mysore State, was given the name Bandite and the suite of metamorphic rocks associated with this granulite, the Bandite series, by Jayaram (1926). The green garnet found in the Bandite was identified as uvarovite by Jayaram, probably on account of its emerald green colour. Though no detailed mineralogical work has been done on this garnet, to confirm Jayaram's identification, in all subsequent literature on these rocks, the green

garnet continues to be referred as uvarovite. As a part of the detailed study of this suite of rocks, the authors have made a mineralogical study of this garnet and the results are reported in this brief note.

Outcrops of the garnet bearing granulite in this area are found in association with rocks like quartzite, hornblende-diopside granulite, cordierite-sillimanite gneiss, cordierite-anthophyllite granulite, etc. The garnetiferous band has an average width of about 10 metres, and is traceable over a length of 2 kilometres. On the weathered surface beautiful crystals of green garnet are seen projecting with well-developed dodecahedral faces. They vary in grain size from a fraction of a mm. to one cm. The colour is uniformly green. In thin sections it has a light green colour with distinct relief. The other minerals present are diopside, sphene, idocrase, iron ore, zircon and quartz. The unit cell dimension calculated from the X-ray powder photograph, refractive index and the specific gravity are given in Table I along with similar data for uvarovite and grossularite for comparison.

TABLE I

Mineral	Unit cell dimension a (Å)	Specific gravity	Refractive index
Uvarovite ..	11.922	3.809	1.821-1.829
Mineral studied..	11.80	3.56	1.75
Grossularite ..	11.825	3.77	1.772

A pure sample of the garnet under study has been chemically analysed and its chemical composition is recorded in Table II along with the calculated molecular percentage of the end members.

TABLE II

Constituents	Wt. percentage	Calculated molecular % of the end members
SiO ₂	39.88	..
TiO ₂	0.43	Grossularite 63.45
Al ₂ O ₃	17.38	Andradite 15.52
Fe ₂ O ₃	5.21	Almandine 12.48
Cr ₂ O ₃	0.90	Pyrope 5.91
FeO	4.10	Uvarovite 2.63
MnO	tr.	..
MgO	1.08	..
CaO	31.26	..
Total ..	100.24	

Analyst: B. Somasekar.

Repeated determinations of Cr₂O₃ content in the mineral have shown a consistent value of 0.9%. In one of the works on uvarovite

Isaacs (1965) has regarded many chrome-bearing garnets as uvarovite and has brought down the lower limit of Cr₂O₃ content in uvarovite to 3.39%. The recorded Cr₂O₃ % in the garnet under study is far below this lower limit and for this reason it cannot be regarded as uvarovite. The properties recorded in Tables I and II clearly show that the garnet under study is a green grossularite. Though the more typical colours of grossularite are golden yellow or brownish red, the presence of nearly one percent of Cr₂O₃ has probably imparted green colour to this mineral.

The authors are thankful to Prof. J. Konta of Charles University, Prague, Czechoslovakia, for kindly arranging to get the X-ray powder photographs of this mineral.

Department of Geology,
Karnatak University,
Dharwar, November 6, 1965.

B. SOMASEKAR.
C. NAGANNA.

1. Deer, W. A., Howie, R. A. and Zussman, J. *Rock-forming Minerals*, Longmans, London, 1962, 1.
2. Isaacs, T., "A Study of Uvarovite", *Min. Mag.* 1965, 35 (269), 38.
3. Jayaram, B., "Progress report on work done during the field season of 1922-23," *Rec. Mys. Geol. Dept.*, 1926, 23, Part II, 57.

FURTHER OBSERVATIONS ON GRAPTOLITES FROM THE KASHMIR HIMALAYAS

In continuation of our earlier communication¹ on the above additional material has been investigated.

The investigation reveals that the horizon 30 ft. below *Monograptus cf. dubius* contains nine examples of graptolites resembling tuning fork Didymograptids (Figs. 1, 2). None of these, however, shows preservation of the sicular region. Should the assignation to *Didymograptus* be justified the presence of Llanvirn strata is indicated.



FIG. 1. Tuning fork Graptolite from the lowermost horizon, $\times 2$.

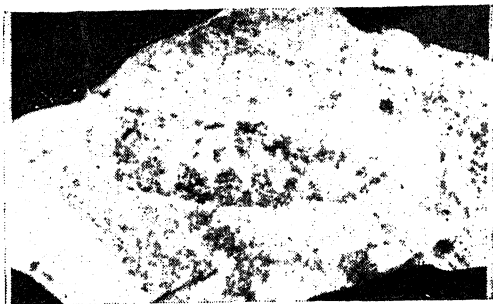


FIG. 2. Tuning fork Graptolite from the lowermost horizon, $\times 3$.

The sequence which is in mudstone throughout, as at present interpreted, is as follows:

Monograptus cf. dubius (Suess) Lower Ludlow
3 ft.

Monograptus cf. vulgaris (Wood)
27 ft.

F..... ? ? F
Didymograptus of tuning fork habit. ? Llanvirn

The succession is rather perplexing in that the tuning fork kinds appear only a relatively few feet beneath the Early Ludlow forms. Faulting has perhaps intervened and made the rocks bearing the tuning fork kinds appear in close stratigraphic proximity to the apparently much younger rocks.

The authors are thankful to Sir C. J. Stubblefield, Director, Geological Survey of Great Britain, for his comments.

Department of Geology, M. R. SAHNI.
Panjab University, V. J. GUPTA.
Chandigarh, April 12, 1965.

1. Sahni, M. R. and Gupta, V. J., *Nature*, Dec. 12, 1964, 201, No. 4963.

A REPORT ON THE OCCURRENCE OF AN ABERRANT CNIDARIAN *HALAMMOHYDRA OCTOPODIDES* REMANE, IN INDIAN WATERS

WHILE engaged in the study of the interstitial fauna in the sandy beaches of Waltair coast we have frequently come across specimens of the aberrant hydrozoan *Halammohydra octopodides* Remane along with several other interesting interstitial forms. The form is so far known to inhabit only the European coasts. Remane¹ described the species from the Baltic and the North Sea coasts and later it has been reported from the coasts of Sweden (Dahl²), Atlantic (Teissier³; Swedmark⁴; Renaud-Debyser⁵) and Mediterranean (Swedmark⁶).

The individuals on this coast conform to the description given by earlier workers (Remane¹; Swedmark and Teissier⁷). The body column in the European species attains a length of 0.3 to 0.4 mm. while it reaches 0.2 to 0.3 mm. in the local forms. Adult specimens bear 10 to 12 tentacles measuring 0.4 to 1.0 mm. in length when extended, alternating with 6 lithocysts. Remane¹ described the number of the tentacles in the Kiel specimens as 10 to 13 while Swedmark⁸ found that the Roscoff specimens had 6-24 tentacles.

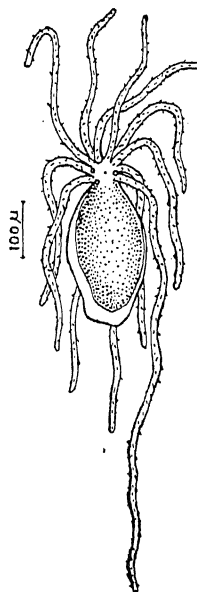


FIG. 1.

The forms occur throughout the year in coarse and medium sands, 10 cm. below surface, between the low and the mid-tide levels of the beach. The species is known to inhabit the finer sand grades also on the European coasts (Swedmark⁸) but locally the forms were never found to occur in fine sands. They showed preference for substrates with coarser sand grades between 300-600 μ in their mean diameter. The temperature in the habitat varies from 26° to 30° C. while the salinity ranges from 24 to 34‰. Observations indicated that the species is omnivorous in its diet, feeding on vegetable and animal matter such as diatoms, protozoans, nematodes, gastrotrichs, copepods, etc.

Dept. of Zoology, G. CHANDRASEKHARA RAO.
Andhra University, P. N. GANAPATI.
Waltair, October 18, 1965.

1. Remane, A., *Zeitschr. Morphol. Oekol.*, 1927, 7, 643.
2. Dahl, E., *Kungl. Fysiogr. Sallk. Lund Forhandl.*, 1952, 22 (18), 112.
3. Teissier, G., *Arch. Zool. exp. gen.*, 1950, 87 (1), 1.
4. Swedmark, B., *Ibid.*, 1956, 93 (1), 43.
5. Renaud-Debyser, J., *Cah. Biol. Mar.*, 1964, 5, 111.
6. Swedmark, B., *Arch. Zool. exp. gen.*, 1956, 93 (2), 70.
7. — and Teissier, G., *Bull. Soc. Zool. France*, 1957, 82 (1), 38.
8. —, *Coli. Biol. Mar. Roscoff Ann. Biol.*, 1957, 33 (3-4), 183.

MALE AND FEMALE GAMETOPHYTES, AND ENDOSPERM IN *VACCINIUM* *LESCHENAULTII*, W.

PRELIMINARY observations on the embryology of *Vaccinium leschenaultii* collected from Kodaikanal are reported here. Except *Cassiope*, which shows *Allium* type (Palser, 1961), other members of the Ericaceae are reported to have *Polygonum* type of embryo-sac. In the majority of the genera investigated, the endosperm is cellular (*see*, Ganapathy and Palser, 1964).

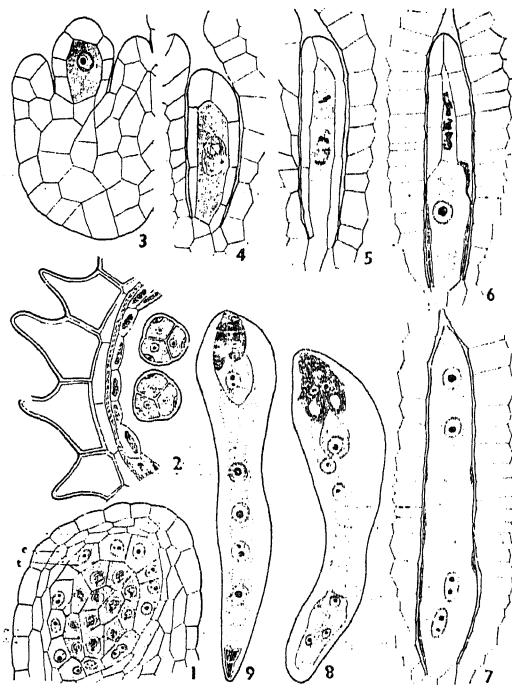
In transection the young anther is four-lobed and its wall comprises single layers of epidermis, endothecium, middle layer and tapetum (Fig. 1). The epidermis persists in the mature anther and becomes distinctly papillose in the later stages (Fig. 2). By about the time the microspore mother cells enter meiotic divisions the middle layer gets obliterated. The tapetum is glandular and becomes non-functional by the two celled-stage of the pollen-grains. The endothecium does not develop fibrous thickenings, as the pollen is shed through the apical awns of the anthers. Sterility of pollen sacs is very common.

The meiotic divisions of the microspore mother cells are simultaneous forming isobilateral or tetrahedral tetrads. The nucleus in each microspore divides and this division results in a large tube cell and a small generative cell, which lies towards the outer side of the tetrad (Fig. 2). The pollen-grains do not separate but remain in tetrads (Fig. 2).

The ovule is unitegmic and tenuinucellate. A hypodermal archesporial cell differentiates in the ovular primordium (Fig. 3). More than one archesporial cell also occurs. The archesporial cell enlarges and functions directly as a megaspore mother cell (Fig. 4). Rarely two megaspore mother cells are met with and they may be arranged in a juxtaposed or superposed manner. Subsequently only one of them develops further while the other degenerates.

During the first meiotic division of the megaspore mother cell two nuclei are formed

and they are separated by a transverse wall resulting in two superimposed dyad cells (Fig. 5). The divisions of the dyad cells are synchronous usually and are followed by walls resulting in four megaspores which are arranged in a linear tetrad. Occasionally the micropylar dyad cell may slightly lag behind. Of the four megaspores the chalazal one usually functions and the micropylar three degenerate (Fig. 6). The degeneration of the megaspores normally starts from the chalazal non-functional megaspore towards the micropylar ones. Sometimes it may begin from the micropylar megaspore.



FIGS. 1-9. Fig. 1. Transection of young anther (e, endothecium; t, tapetum), $\times 240$. Fig. 2. Part of older microsporangium showing two-celled pollen-grains in tetrads, $\times 400$. Fig. 3. L.S. ovule showing archesporial cell, $\times 400$. Figs. 4-5. Megasporogenesis, $\times 400$. Fig. 6. Functional megaspore, $\times 400$. Fig. 7. Four-nucleate embryo sac, $\times 400$. Fig. 8. Mature embryo sac, $\times 240$. Fig. 9. Four-nucleate endosperm, $\times 240$.

The functional megaspore enlarges in size and vacuoles appear at the micropylar and chalazal ends. The nucleus divides and the two daughter nuclei move towards the opposite ends by the formation of a large central vacuole. The degeneration of the nucellar cells starts when the functional megaspore grows larger and extends towards the micropylar end (Fig. 6). At the two-nucleate stage, the embryo-sac comes directly in contact with the

inner layer of the integument which functions as the endothelium. The cells of the endothelium have large nuclei and dense cytoplasm. At about four-nucleate stage the nucellus may be completely destroyed or a few remnants of the cells may be seen surrounding the embryo-sac (Fig. 7).

The mature embryo-sac is eight-nucleate (Fig. 8). The egg apparatus consists of an egg and two hooked synergids, with filiform apparatus. The synergids are ephemeral. The egg projects beyond the synergids. The polar nuclei do not fuse before fertilization but remain in close association either at the centre of the embryo-sac or below the egg (Fig. 8). The antipodal cells are three in number and each is uninucleate. They persist for a long time.

The first division of the primary endosperm nucleus is not followed by a wall. The next division is also free nuclear resulting in four free endosperm nuclei (Fig. 9). Walls are laid between the four free nuclei to form a four-celled endosperm. The third division is vertical in all the four cells and results in an eight-celled endosperm where the cells are arranged in four tiers of two cells each. The terminal two tiers give rise to their respective micropylar and chalazal haustoria, and the two middle tiers to the endosperm proper. The haustoria become multinucleate and due to their enlargement the surrounding integumentary cells get used up.

Although the majority of genera in the Ericaceae show the cellular endosperm our observations, which are in concurrence with those of Peltriset (1904) and Bell (1957), on *Vaccinium* reveal the occurrence of free nuclear endosperm. Similarly Creech (1955) also found a row of four free endosperm nuclei in *Rhododendron*. In view of the fact the *Vaccinium* has been placed in the Vacciniaceae by Bentham and Hooker and in the Ericaceae by Engler and Prantl, further embryological studies of the genus may throw more light on its systematic position.

The authors wish to express their gratitude to Prof. K. N. Narayan for his encouragement during the course of this investigation.

Department of Botany, K. B. S. MURTHY REDDY.
Manasa Gangotri, R. NARAYANA.
University of Mysore,
Mysore-2 (India), October 22, 1965.

1. Bell, H. P., *Can. J. Bot.*, 1957, **35**, 139.
2. Creech, J. L., *Bot. Gaz.*, 1955, **116**, 234.
3. Ganapathy, P. S. and Palser, B. F., *Bot. Gaz.*, 1964, **125**, 280.
4. Palser, B. F., *Recent Advances in Botany*, Toronto Univ. Press, 1961, p. 685.
5. Peltriset, C. N., *J. de Botan.*, 1904, **18**, 309.

DIDYMOBOTRYUM ATRUM PAT. AND LASMENIA FICINA SYDOW, H. AND P., FROM COFFEE ESTATES IN MYSORE

THE author during the course of his investigations on the "new malady" of coffee has been coming across several interesting fungi which have not been reported from this country in the past.

In this brief note is presented illustrations and description of a member of the didymosporous phaeostilbeae and another belonging to the leptostromataceae of Sphaeropsidales.

Didymobotryum atrum Pat., *J. Bot.*, p. 320, 1891, Saccardo, *Syll. Fung.*, 10: 699, 1892.

The synnemata of this fungus are sparse and appear as fine, discrete bristles on the surface of the substratum; they are filiform upto 1.5 mm. tall, mostly 0.75 mm. long; stipe erect, cylindrical, almost black, measuring upto 25 μ in diameter at the upper end and upto 90 μ at the base, composed of dark brown, septate, closely adpressed, parallel hyphae which are upto 3 μ in diameter; the fruiting area is globose to subglobose upto 160 μ in diameter; conidia light brown when young, fuscous when mature, cylindrical, medianly one septate, smooth thick-walled, constricted in the middle, obtuse at the apex, sub-papillate at the base 16-19 by 4-6 μ (Fig. 1).

The specimen was collected by Mr. C. C. Chinnappa, on an undetermined host (Bamboo?) at the Central Coffee Research Institute, Balehonnur, Chickmagalur district, dated 3/8/1965.

Lasmenia ficina Sydow H. and P. in *Philippine Journal of Science*, 8, p. 281, 1916.

The fungus forms erumpent, epiphyllous stromata which are round, irregular, of different shapes, measuring upto 2 mm. in diameter, the stromata are typically phyllachoroid, often confluent, greyish-black to tarry black with undulating, shiny surface, locules within the stroma are 6-10 in number, spores globose, continuous, with a smooth wall, pale brownish in colour and upto 9 μ in diameter, paraphyses filiform (Fig. 2).

Collected on several occasions on living leaves of *Ficus glomerata* Roxb. in association

with *Phyllachora* spp. and *Stigmina maculata* (Cooke) Hughes.

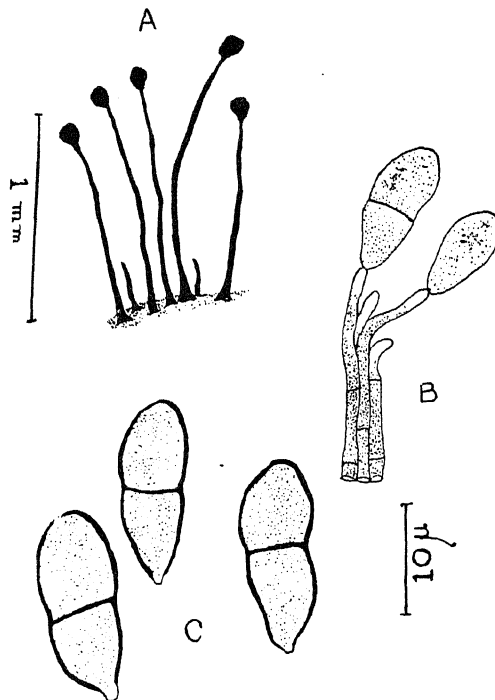


FIG. 1. *Didymolotryum atrum* Pat. A. A group of synnemata. B. Conidiophores and Conidia. C. Conidia.

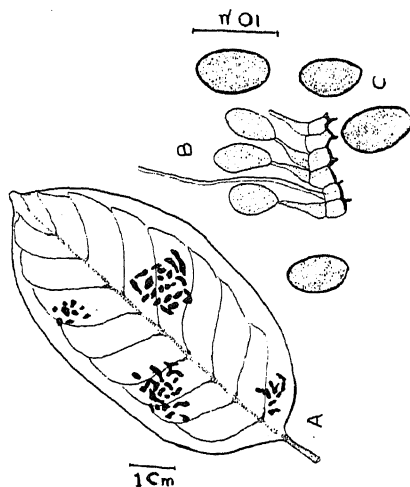


FIG. 1. *Lasmenia ficina* Sydow, H. & P. A. Leaf of *Ficus glomerata* Roxb. showing the stromata. B. Conidiophores, paraphysis and spores. C. Spores.

From the available literature, it would appear that *Lasmenia globulifera* (Rab.) von Höhnel [= *Lasmeniella globulifera* (Rab.)

Petrak & Sydow] was described by Sydow and Butler¹ from India on *Bauhinia vahlii* W. & A.

The author is grateful to the General Manager, Fertiliser and Pesticides Division, Rallis India Limited, for permission to publish this note and to Dr. C. Booth and Dr. M. B. Ellis of Commonwealth Mycological Institute for their help with the literature.

Rallis India Limited,
F. & P. Division,
P.O. Box No. 68,
Bangalore-1, October 30, 1965.

V. AGNIHOTHRUDU.

1. Sydow, H. & P. and Butler, E. J., *Ann. Myc.*, 1916, 14, 194.

ON THE OCCURRENCE OF NATURAL POPULATION OF *RAUWOLFIA* *SERPENTINA* IN JAMMU

Rauwolfia serpentina is found growing wild in the Sub-Himalayan tracts and along the Gangetic plains in Bihar, Bengal and Assam as well as in parts of Central India, and along the Western Ghats. So far there has been no record of this plant growing west of the river Bias. The nearest region of collection made by us was Dehradun valley and Rishikesh.

In April of this year one of us (S. D. Singh) while out on a cross country track in the region of Gajansu, Kripalpur and Machial came across a plant, of *Rauwolfia serpentina* near Kripalpur. On proceeding further along the bank of the river Chenab, the plant was found growing gregariously. A second trip made in May by us revealed an area of about 4 miles in which the plant was abundant. It was found growing in association with *Murraya koenigii* and *Saccharum* species. It is probable that seeds of *R. serpentina* were brought down by the river from higher altitude to Jammu area. Cytogenetical studies showed it to be a diploid with $2n = 22$.

Chemical analysis of root showed the total alkaloid content to be 2.5% which is higher than the Dehradun form in which it is 1.0% only. It is closer to the Rishikesh form in which the alkaloid content was found to be 2.66% (R. D. Dhar in Press).

Regional Research Lab., E. K. JANAKI AMMAL.
Jammu, S. D. SINGH.
December 2, 1965. R. D. DHAR.

1. Dhar, R. D., Variation in the alkaloid content and morphology of 4 Geographical races of *Rauwolfia serpentina*, *Proc. Ind. Acad. Sci.*, 1965 (in press).

REVIEWS AND NOTICES OF BOOKS

Advances in Mathematics. Edited by Herbert Busmann. (Academic Press, New York and London), 1964. Pp. 264. Price \$ 5.50.

The need for expository articles addressing either all mathematicians or only those in somewhat related fields has long been felt, but little has been done outside of the USSR. The series "Advances in Mathematics" was created in response to this demand. It will appear in fascicles containing one or more articles, which will be combined into volumes.

The following is the titles of the chapters contained in this volume: Die Theorie der geometrischen Ordnungen, by Hermann Kunneth; Lie Groups in the Foundations of Geometry, by Hans Freudenthal; Some Results on Surface Theory in the Large, by A. V. Pogorelov.

C. V. R.

Histones and Other Nuclear Proteins. By Harris Busch. (Academic Press, New York and London), 1965. Pp. xiii + 266. Price \$ 9.50.

The present volume was designed to be an introduction to the current status of research and knowledge in the field of nuclear proteins. The orientation has been to provide the student or research worker with a view of the subject that permits its ready comprehension and at the same time indicates the areas where new research is required. The subject-matter is dealt with in two parts, viz., The Basic Nuclear Proteins and the Acidic Nuclear Proteins and the Nuclear Enzymes. Part I contains the following seven chapters: I. The Protamines; II. Types, Composition, and Number of Histones; III. Isolation of the Histones; IV. Spatial Relationships between DNA and Histones; V. Functions of the Histones; VI. The Primary Structure of Histones; VII. Metabolism of Histones. Part II contains the following two chapters: I. The Acidic Nuclear Proteins; II. Nuclear Enzymes.

C. V. R.

Stability of Nonlinear Control Systems (Vol. 13). Mathematics in Science and Engineering. Richard Bellman Series. Edited by Solomon Lefschetz. (Academic Press, New York and London), 1965. Pp. xi + 150. Price \$ 7.50.

This monograph discusses the latest material on nonlinear control theory as it has developed from the direct stability method of Piapunov.

Although the work includes the most recent research in the field, the text presupposes little more than a basic knowledge of standard vector-matrix technique and the existence properties of ordinary differential equations. There are nine articles in this book whose titles are as follows: 1. Introductory Treatment of Dimensions One and Two; 2. Indirect Controls; 3. Indirect Controls (Continued); 4. Direct Controls. Linearization Multiple Feedback; 5. Systems Represented by a Set of Equations of Higher Order; 6. Discontinuous Characteristics; 7. Some Recent Results of V. M. Popov; 8. Some Further Recent Contributions and 9. Miscellaneous Complements.

C. V. R.

The Harvey Lectures—Series 59. (Academic Press, New York and London). Pp. xiv + 311. Price \$ 9.50.

This book represents the collection of *The Harvey Lectures* delivered under the auspices of *The Harvey Society* of New York, 1963-64.

The following is the list of the titles of the lectures and their respective authors: 1. Transport of Electrolytes and Water Across Epithelia, by Hans H. Ussing; 2. A Total Synthesis of Colchicine, by R. B. Woodward; 3. The Separation and characterization of Subcellular Particles, by Christian de Duve; 4. The Importance of Artificial Peptides in Elucidation of Physiological Events, by Klaus Hofmann; 5. Cell Transformation by Viruses as Illustrated by the Response of Human and Hamster Renal Cell to Simian Virus 40, by John F. Enders; 6. Protein Synthesis and the RNA Code, by Marshall Nirenberg; 7. Developmental Genetics, by Clement L. Markert; 8. Myeloma Proteins and Antibodies, by Henry G. Kunkel; Use of Poly-a-Amino-Acids in Biological Studies, by Ephraim Katchalski.

C. V. R.

Berkeley Physics Course (Vol. 2). Electricity and Magnetism. By Edward M. Purcell. (Published by McGraw-Hill Book Company, International Division, 330 West 42nd Street, New York, 10036), 1965. Pp. 450. (8½" × 9½").

The modern advancement in science and engineering has called for a complete reorientation in teaching of physics at elementary level in pre-university and undergraduate classes. Many publications have come out recently for this purpose. But the volumes of the Berkeley

Physics Course, intended as a two-year course in physics for beginning college students of science and engineering, stand unique in this respect. The five volumes of this series have been written by well-known physicists of American Universities, and as pointed out in the Preface, the intention of the writers has been "to present elementary physics as far as possible in the way in which it is used by physicists working in the forefront of their field. The course would vigorously emphasise the foundations of physics". The five volumes are: Mechanics, Electricity and Magnetism, Waves and Oscillations, Quantum physics, and Statistical physics.

Volume 2 under review is the course on Electricity and Magnetism by E. M. Purcell. The sequence of topics appears usual, namely, electrostatics, potential and field, steady currents, magnetic field, electro-magnetic induction, alternating currents, electric fields in matter, and magnetic fields in matter. However, the treatment is fundamentally different from the usual one. It focuses attention on questions like charge conservation, charge invariance, the meaning of field, etc., and introduces the student to vector calculus, gradient, divergence, curl, Laplacian, etc. The figures are exquisitely drawn to drive home the treatment in the text.

A course of this type has become essential at undergraduate levels of teaching in Indian Universities, and we recommend the publication to those in charge of framing syllabuses and organizing refresher courses for teachers.

A. S. G.

Text-Books in Science Published by Asia Publishing House, Calicut Street, Ballard Estate, Bombay-1.

Elements of Differential Calculus. By B. S. Fadnis, 1965. Pp. 296, Price Rs. 24-00.

This is not the usual type of text-books on differential Calculus. In the presentation of the material the author has adopted a wholesome new approach which will evoke the thinking power of the student and thus make the application of calculus to problems an entertaining task. A number of problems have been solved in the text to bring home the analytical approach used to deal with the applications. A knowledge of elements of calculus and techniques of differentiation is assumed on the part of the reader. A useful text-book to graduate and honours students of mathematics, physics, and engineering.

Physico-Chemical Techniques of Analysis (Vol. I). By P. B. Janardhan. Pp. 356. Price Rs. 32-00.

Rapid expansion of industry in the country has called for quicker and more accurate techniques of chemical analysis, and also personnel well qualified in the use of these techniques. The book describes instrumental techniques commonly used in industry and analytical laboratories, and it will provide a useful introduction to graduate students in analytical chemistry desiring to take up analytical work in industry or laboratories. The techniques dealt with are: Absorptiometry; Conductometry, Coulometry and Polarography; High frequency analysis and Electro-deposition analysis; Chromatography; Spectroscopy, Raman spectroscopy, Mass spectra, and X-ray methods; Magnetochemical analysis.

A Hand-book of Systematic Botany. By Subhash Chandra Datta. Pp. 435. Price Rs. 18-00.

This is a good text-book on angiosperms suitable for Degree course students. It deals with 70 families of flowering plants prominent in India. The text is supplemented by numerous diagrams, and scientific as well as Indian names of the plants are given.

The contents are divided into five parts dealing respectively with (1) Principles and practices of taxonomy, (2) Selected families of flowering plants, Dicotyledons, (3) Monocotyledons, (4) Special topics on angiosperms, and (5) Aid to taxonomic studies.

Elements of Structural Geology. By E. S. Hills, 1965. Pp. 453. Price Rs. 16-00.

This is the first Indian edition of the book written by the well-known author Professor E. S. Hills. The book gives a comprehensive account of all topics connected with structural geology, and contains numerous illustrations discriminately chosen from examples in all continents. The chapter on Structural Petrology is written by Dr. Eden Tex.

A. S. G.

Advances in Gerontological Research (Vol. 1). Edited by Bernard Strehler. (Academic Press, New York and London), 1964. Pp. xi + 410. Price \$13.50.

This series is intended to provide critical analyses, reviews and syntheses of specific logical subdivisions in gerontology.

The volume under review contains the following chapters: Histophysiology of the Aging Nervous System, by William Bondareff; Proteins in Development and Senescence, by

Simion Oeriu; Changes in the Nucleus with Advancing Age of the Organism, by Warren Andrew; Similarities and Contrasts between Radiation and Time Pathology, by George W. Casarett; Cross-Linkage and Aging, by F. Marott Sinex; The Nucleic Acids in Development and Aging, by Zh. A. Medvedev; Genetic Factors Associated with Aging, by Arnold M. Clark; Isolated Lipofuscin Granules—A Survey of a New Field, by Soren Bjorkerud; Autoimmunity in Aging, by Herman T. Blumenthal and Aline W. Berns; on the Histochemistry and Ultrastructure of Age Pigment, by Bernard L. Strehler.
C. V. R.

Molecular Pharmacology (Vol. II). Edited by E. J. Ariens. (Academic Press, New York and London), 1964. Pp. xi + 280. Price \$10.00.

This book will be of interest to anyone dealing with the biological activity of chemical compounds, including, in addition to pharmacologists, workers in the field of general therapeutics, chemotherapy of infectious diseases, cancer research, pesticides, phytopharmacology, olfaction, and related disciplines. The information in the volumes will also be of use to biochemists, physiologists, and endocrinologists using chemical compounds as tools in their research.

The authors approach the pharmacological aspects of their specific fields on the basis of the physico-chemical interaction of the molecules of these pharmacodynamic substances with the molecules of the biological object. C. V. R.

Cytogenetics of Cells in Culture (Vol. 3). *Symposia of the International Society for Cell Biology.* Edited by R. J. C. Harris. (Academic Press, New York and London), 1964. Pp. xii + 313. Price \$13.00.

The contributors to this symposium were carefully selected by the Advisory Committee of the International Society for Cell Biology from laboratories around the world because of their courage to explore new frontiers of cytogenetics with the confidence gained from extensive experience in the field.

The contributions contained in this volume are as follows: Cytogenetic Alterations in Mixed Cultures of Mammalian Somatic Cells *in vitro*; Hybridization of Somatic Cells *in vitro*; Selection Pressure in Mammalian Cell Populations; Phase Cinematography Studies on the Effects of Radiation and of Some Chemicals on Cells and Chromosomes; Cellular Interpretation of Aspects of the Acute Mammalian Radiation Syndrome; Retention of Euploidy and

Mutagenicity of Heterochromatin in Culture; The Nature, Origin, and Genetic Implications of Structural Abnormalities of the Sex Chromosomes in Man; Chromosome Studies in the General Population; Alterations Chromosomiques dans des Cellules Cultivees en Presence d'Extraits Tissulaires Heterospecifiques; Chromosomal Studies on Human Leucocytes Following Treatment with Radioactive Iodine *in vivo* and *in vitro*; The Limited *in vitro* Lifetime of Human Diploid Cell Strains; Regulation of DNA Replication and Variegation-Type Position Effects; Identification and Characterization of Human Chromosomes; by DNA Replication Sequence; Mutagenic Response of Human Somatic Cell Lines; DNA Synthesis and Chromosomal Morphology of Chinese Hamster Cells Cultured in Media Containing N-Deacetyl-N-Methyl-Colchicine (Colcemid); Heterochromatin in the Human Male; Chromosome Breakage Associated with Viruses and DNA Inhibitors; Quantitation and Automation of Chromosomal Data with Special Reference to the Chromosomes of the Hamshire Pig (*Sus scrofa*).
C. V. R.

Advances in Pharmacology (Vol. 3). Edited by Silvio Garattini and Parkhurst A. Shore. (Academic Press, New York and London), 1964. Pp. viii + 341. Price 86 sh.

The present volume of this well-known series contains the following articles: (1) Experimental Approaches to the Development of Antianginal Drugs, by Martin M. Winbury; (2) Pharmacological Aspects of Parkinsonism, by Alexander H. Friedman and Guy M. Everett; (3) The Pharmacology and Biochemistry of Parasitic Helminths, by Tag E. Mansour; (4) The Adrenergic System and Sympathomimetic Amines, by E. Marley; (5) Pharmacological Aspects of Drug Dependence, by G. A. Deneau and M. H. Seever and (6) Drugs Used in Control of Reproduction, by G. Pincus and G. Bialy.

V. S. RAMASWAMY.

Progress in Chemical Toxicology (Vol. 2). Edited by A. Stolman. (Academic Press, New York and London), 1965. Pp. x + 416. Price \$14.00.

This new continuing series presents vital information on problems confronting the toxicologist, clinical biochemist, pathologist, and pharmacologist. The articles contained in this book and their respective authors are as follows: 1. The Absorption, Distribution, and Excretion of Poisons and Their Metabolites, by A. Stolman

and C. P. Stewart; 2. Detection of Volatile Organic Compounds and Toxic Gases in Humans by Rapid Infra-red Techniques, by Richard D. Stewart and Duncan S. Erley; 3. An Approach to the Analysis of Biological Specimens for Basic Drugs, by Leo R. Goldbaum and Thaddeus J. Domanski; 4. Rapid Methods of Toxicological Analysis by Ion-Exchange Paper Chromatography and Ionophoresis, by Harold V. Street; 5. Developments in Spectrography: Sample Preparation, by Leo A. Dal Cortivo and Michael Cefola and 6. Thin Layer Chromatography Application in Toxicology, by Abraham Stolman.
V. S. RAMASWAMY.

Developments in Handling and Processing Fish.

By G. H. O. Burgess [Fishing News (Books) Ltd., 110, Fleet St., London, EC 4], 1965. Pp. 132. Price £1-5-0.

This is a Buckland Foundation Book—one of a series providing a permanent record of annual lectures maintained by a bequest of the late Frank Buckland (1826-1880), a pioneer of fishery research.

The author who is connected with the Torny Research Station in Aberdeen, a widely recognized centre of research into problems of the handling and preservation of fish and fish products, brings out in these lectures a broad outline of the historical development of some of the modern methods of handling and processing fish. He also discusses the technological problems currently confronting the British fish industry. Although the lectures are intended for a British audience, the contents of this publication will have a wider appeal to all those interested in the application of scientific methods to fish processing and handling.

Besides a pictorial section of 8 pages of photographs on modern handling and processing of fish, the book contains a number of etch block illustrations of interest. A. S. G.

Discovery Reports, Vol. XXXIII (309-334): *The Latitudinal Distribution of Euphausia Species in the Surface Waters of the Indian Ocean.* By A. de C. Baker. (Cambridge University Press), 1965. 17 sh. 6d.

The Discovery Reports issued by the National Institute of Oceanography are scientific documents of great value, especially to students of marine ecology. In the present Report the Latitudinal ranges of sixteen species and one

variety of *Euphausia* are described. Most of the material used in this study was collected, by means of oblique tows from about 100 m. to the surface, during the voyage of R.R.S. "Discovery II" in 1950-51. The stations were worked along 90° E. meridian and extended from the Equator to the Antarctic continent. The Report analyses the latitudinal distribution of *Euphausia* in relation to the varying features of the environment in this north-south traverse of the Indian Ocean. The data are presented in the form of graphs and charts, and related where possible to previous observations in the Indian Ocean. A comparison of the distribution of the species common to both the Indian and the Pacific Oceans shows that in the Pacific they tend to have less extensive north-south ranges.

A. S. G.

Books Received

Solid State Physics (Vol. 17)—*Advances in Research and Applications.* Edited by F. Seitz, D. Turnbull. (Academic Press, New York and London), 1965. Pp. xvii + 379. \$14.00.

Advances in Child Development and Behaviour (Vol. 2). Edited by L. P. Lipsitt, and C. C. Spiker. (Academic Press, New York and London), 1965. Pp. x + 269. Price \$8.50.

Mechanisms of Hormone Action. Edited by Dr. P. Karlson. (Academic Press, New York and London), 1965. Pp. 275.

Perspectives in Modern Biology—Selected Papers on Molecular Genetics. By J. H. Taylor. (Academic Press, New York), 1965. Pp. 649. Price \$95.

Organic Chemistry a Series of Monographs. (Vol. 4)—*Fundamentals of Carbanion Chemistry.* By Donald J. Cram. (Academic Press, New York, London), 1965. Pp. viii + 289. Price \$9.50.

Documents on Modern Physics—The Dynamics of Conduction Electrons. (Gordon & Breach, New York-11), 1965. Pp. 150. Price \$4.95.

Mechanics. By W. F. Osgood. (Dover Publications, New York), 1965. Pp. xiii + 495. Price \$2.50.

Introduction to Physics. By A. Kitaigorodsky. (Dover Publications, New York), 1965. Pp. 719. Price \$3.00.

An Introduction to the Use of Generalized Coordinates in Mechanics and Physics. By W. E. Byerly. (Dover Publications, New York), 1965. Pp. vii + 118. Price \$1.35.

THE NEW PHYSIOLOGY OF VISION

Chapter XXXVII. The Spectrum of the Night Sky

SIR C. V. RAMAN

THE major result which emerges from the investigations described in the two preceding chapters is that we are concerned with only one kind of vision and its variations in the entire range of illumination in which our eyes can perceive light. The differentiation made in the past between three distinct types of vision named as "photopic vision", "mesopic vision" and "scotopic vision", and functioning at different levels of illumination is shown by the factual results of the study to possess no valid basis or justification. In what follows, it will be shown that the characteristic features of human vision at low levels of brightness ascertained by spectroscopic methods and described in the two preceding chapters can be demonstrated in a very simple and striking fashion with the aid of appropriate colour filters.

On any clear moonless night, the light which reaches ground-level is principally that received from the stars overhead. Some of it comes from the very bright stars which are the most conspicuous objects in the night-sky. A substantial contribution is also made by the fainter stars of various magnitudes which can individually be perceived by an observer. Far more numerous are the faintest stars which cannot be perceived individually but which in the aggregate make a notable contribution to the observed luminosity of the sky. When these faint stars are present in great numbers in any particular area, *e.g.*, in the Milky Way, the resulting diffuse luminosity of the sky is quite conspicuous. Nevertheless, except in the case of the very brightest stars, the luminous flux which reaches the eye of an observer from an individual star or from any limited area in the sky is extremely small.

That our visual perceptions are very different at low levels of illumination from what they are in bright light is made strikingly evident when the night-sky is viewed through a plate of glass which freely transmits light of wavelengths greater than $600\text{ m}\mu$ and is opaque to shorter wavelengths. Such a plate exhibits a bright red hue by transmitted light in daytime. Held against the night-sky, it resembles a sheet of black glass, completely obscuring both the individual stars and the general luminous background of the sky. Only the very brightest stars, *viz.*, Sirius and a few others can be

glimpsed through the filter as dim red spots of light. Quite different, however, is the appearance in like circumstances of a disk of yellow glass which acts as a colour filter excluding light in the spectral range from $400\text{ m}\mu$ to $500\text{ m}\mu$ and freely transmitting greater wavelengths. Held against the night-sky, the disk appears quite transparent and colourless. Neither the individual stars (except Sirius and a few others) nor the general background of the luminosity appears diminished in brightness when seen through the filter.

From the foregoing observations, it can be inferred that the part of the spectrum which makes a sensible contribution to the perceived luminosity of objects at low levels of brightness is limited to and falls within the range of wavelengths between $500\text{ m}\mu$ and $600\text{ m}\mu$. We can go further towards fixing the part of the spectrum which functions in dim light by making use of colour filters which exclude both the red and yellow sectors of the spectrum and freely transmit the green and blue sectors. Such filters are readily prepared by staining gelatine films with an appropriate dye-stuff, *e.g.*, cyanin, or disulphine blue. They exhibit a bright greenish-blue colour by transmitted light in daytime. But when held against the night-sky, the filters appear quite colourless and completely transparent. No noticeable reduction of brightness either of the individual stars (other than the most highly luminous) or of the background luminosity of the sky results from viewing them through the blue-green filters. Comparative study of the night-sky through the three different types of colour filter thus enables us to conclude that only the green sector of the spectrum, in other words, the wavelength region between $500\text{ m}\mu$ and $560\text{ m}\mu$ is effective in the perception of light at the low levels of illumination with which we are concerned here.

The stated conclusion is confirmed by observations of the night-sky through colour filters of other kinds. Of particular significance is the fact that a filter of glass which transmits light only within the wavelength range between $400\text{ m}\mu$ and $500\text{ m}\mu$, and accordingly exhibits a blue colour by transmission in daylight appears perfectly opaque when held up against the night-sky. Neither the individual stars—except a few of the highest luminosity—nor the general

background of sky-illumination can be perceived through such a filter. A solution of cuprammonium in a flat-sided glass cell with its concentration adjusted to transmit the blue sector of the spectrum and absorb the rest exhibits the same behaviour. These observations establish that the blue region of the spectrum makes no sensible contribution to our perception of very feeble light-sources.

Colour-filters of several sorts can be prepared with the aid of appropriately chosen dye-stuffs which completely eliminate the green sector, in other words, the wavelength range between $500\text{ m}\mu$ and $560\text{ m}\mu$, while the other parts of the spectrum are transmitted more or less freely. For example, a gelatin film heavily dyed with methyl-violet transmits light of a purplish-blue colour in which both the green and the yellow sectors are absent. Likewise, a filter dyed heavily with magenta cuts out the green and the yellow and allows the red and the blue to come through. Rhodamine also absorbs the green and the yellow sectors of the spectrum. The exclusion of the green sector by these filters results in their appearing opaque when held up against the night-sky, neither the individual stars—except those which are very highly luminous—nor the background illumination being visible through them.

Several dye-stuffs can be used to prepare colour filters which appear green in colour by transmitted light in daytime. Spectroscopic examination shows this colour to be the result of a nearly complete absorption of the yellow and red sectors of the spectrum, while the blue sector is also much weakened, and the green sector comes through freely. As examples of such filters may be mentioned those prepared with the dye-stuffs "Fast-Green", "Brilliant Green" and "Lissamine Green". As is to be expected, filters of this description transmit the light of the night-sky very freely, both the background illumination and the feeblest stars being seen clearly through them.

Filters exhibiting diverse colours by transmitted light in daytime may exhibit a partial absorption of the green sector of the spectrum. As examples, we may mention filters which appear of an orange hue in daylight. Such filters exhibit an extinction of the blue as also of the green up to about $545\text{ m}\mu$ and a practically free transmission of greater wavelengths. When viewed through such a filter, the night-sky exhibits a weakening both of the general luminosity and of the brightness of the individual stars. But they continue to be visible.

Filters which appear of a blue colour by daylight but are only partially transparent to the green of the spectrum exhibit a similar behaviour when the night-sky is viewed through them.

The Spectra of Individual Stars—An observer with a replica diffraction grating held before his eye and viewing the sky on a clear moonless night will notice that the stars of exceptionally high luminosity, *e.g.*, Sirius, α -Centauri, Arcturus, Vega, Capella and Rigel are accompanied by brilliantly-coloured streaks of light which are their diffraction spectra of the first and higher orders. Less brilliant stars also exhibit a similar phenomenon but with much diminished intensity. Indeed, in such cases, only the spectra of the first order can be seen and the colours are barely perceptible. The spectra also appear much shortened, the blue and red terminations being hardly noticeable. Fainter stars do not show the phenomenon at all, for the reason that the general luminous background of sky-illumination overpowers the faint diffraction spectra.

It is obviously a matter of interest to ascertain how the spectra of the less luminous stars present themselves to the unaided vision. The observations with colour filters described above demonstrate that the spectral region which is effective in our perceiving most of the stars in the sky is limited to the wavelength range between $500\text{ m}\mu$ and $560\text{ m}\mu$. To observe their spectra directly, it is necessary to exclude the general luminosity of the sky. This requirement may be met by viewing the night-sky through a long narrow slit, the observer and his diffraction grating being located inside a completely darkened room. The spectra of the individual stars are then seen as bright streaks crossing the elongated spectrum of the diffuse general illumination of the sky. Except in the case of the highly luminous stars, the streaks do not extend outside the spectrum of the diffuse illumination.

The question naturally arises whether the spectrum of the so-called "diffuse illumination" of the sky is itself not the result of the superposition of a great number of streaks representing the spectra of the individual stars. Any attempt to answer this question by observational study should evidently be made in specially favourable circumstances, *viz.*, in an observatory situated at a high level and not troubled with the illumination of the sky by the light of neighbouring cities.

ON THE MIRROR POINT DISTRIBUTIONS IN THE MAGNETOSPHERE

P. VENKATARAMAN

National Aeronautical Laboratory, Bangalore

THE charged particle motion in the Van Allen radiation belts is composed of a gyration about a line of force, a uniform motion along this field line and a longitudinal drift around the earth. In a treatment due to Alfvén,¹ this spiralling particle is regarded as an elementary magnetic dipole and it has been shown that under certain conditions, the magnetic moment of this dipole remains an adiabatic invariant of the motion.

The constancy of the magnetic moment leads to the expression

$$\frac{\sin^2 \alpha}{H} = \text{Constant} \quad (1)$$

where α and H stand for the pitch angle of the particle and the intensity of the magnetic field where the particle is incident. If a charged particle crosses the equator at an angle α_e , where the magnetic field intensity is H_e , equation (1) means that the particle gets reflected at a point, known as the mirror point, where the field intensity H_M satisfies the equation

$$\frac{\sin^2 \alpha_e}{H_e} = \frac{1}{H_M} \quad (2)$$

If the earth's magnetic field is treated as that of a dipole, the lines of force and the field intensity have the form

$$r = \rho \sin^2 \theta$$

$$H = \frac{M}{r^3} (1 + 3 \cos^2 \theta)^{\frac{1}{2}} \quad (3)$$

where M is the magnetic moment of the earth's dipole, θ the colatitude, and ρ is a constant. Equation (2) then reduces to

$$\frac{\sin^2 \theta_M}{(1 + 3 \cos^2 \theta_M)^{\frac{1}{2}}} = \sin^2 \alpha_e \quad (4)$$

Here θ_M is the colatitude corresponding to H_M , at the point where the particle is reflected.

A table of numerical estimations, relating θ_M and α_e has been given by Hamlin *et al.*²

In this paper, we have considered the main field of the earth expressed as a spherical harmonic summation and the effect of the non-dipole terms on the mirror points is investigated.

In terms of the potential function, the main geomagnetic field is expressed as

$$V = a \sum_n \sum_m \left(\frac{a}{r} \right)^{n+1} P_n^m(\cos \theta) \{ g_n^m \cos m\lambda + h_n^m \sin m\lambda \} \quad (5)$$

where $p_n^m(\cos \theta)$ is the normalized associated Legendre polynomial and g_n^m and h_n^m are the Gauss-Schmidt coefficients.³ In our discussion,

we have used the values of g_n^m and h_n^m as given by Kern and Vestine.³ The radial, polar and the azimuthal components of the geomagnetic field are respectively given by

$$H_r = - \frac{\partial V}{\partial r}, \quad H_\theta = - \frac{1}{r} \frac{\partial V}{\partial \theta},$$

$$H_\lambda = - \frac{1}{r \sin \theta} \frac{\partial V}{\partial \lambda} \quad (6)$$

Since $dr/H_r = r d\theta/H_\theta$, it follows that the equation to a line of force, in general, has the form

$$r = \rho \text{Exp.} \int_{90}^{\theta} \frac{H_r}{H_\theta} d\theta \quad (7)$$

Our method consisted in solving, numerically, the equation (2) in conjunction with equations (5), (6) and (7) to obtain corresponding values of θ_M and α_e . Numerical evaluations have been carried out on a Ferranti Sirius digital computer. In the formula for the geomagnetic field terms upto $n=4$, $m=4$ are retained. As a first approximation $r = \rho \sin^2 \theta$ (dipole case) has been employed in the integrand of equation (7) and keeping λ a constant in the expression of the magnetic field, r is obtained at different θ_M . Keeping λ a constant is tantamount to considering the path of the charged particle on a plane $\lambda = \text{constant}$. Further, the value of r at $\theta = 90^\circ$ has been regarded as the average of r at $\theta = 89^\circ$ and r at $\theta = 91^\circ$. From the table of values of θ_M and α_e thus obtained, θ_M 's are re-evaluated at some desired values of α_e by means of inverse interpolation. The distribution of mirror points with respect to the longitude is shown schematically in Fig. 1. While the continuous curves

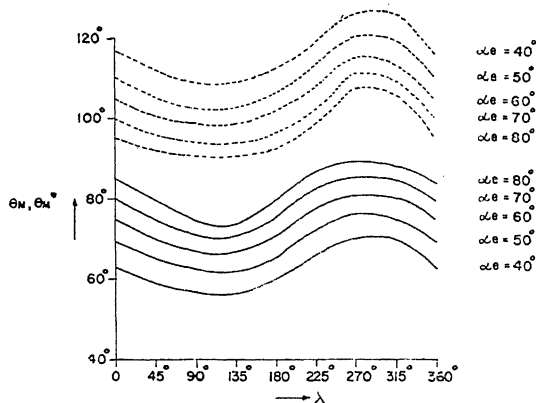


FIG. 1.

relate to the Northern hemisphere, the dotted curves pertain to the Southern hemisphere. In Table I, we have given numerical values of θ_M and θ_{M^*} at some longitudes. It can be noted that

TABLE I

$\alpha_0 = 40^\circ$			$\alpha_0 = 80^\circ$		
λ^0	θ_M^0	$\theta_{M^*}^0$	λ^0	θ_M^0	$\theta_{M^*}^0$
0	62.92007	116.6652	0	85.1737	94.9865
45	59.17703	112.2483	45	79.1285	92.1337
90	57.0279	109.4838	90	74.6924	91.5340
135	56.3157	109.1483	135	73.9306	91.3635
180	59.5042	112.1550	180	79.6675	92.2540
225	66.1607	118.4004	225	86.5975	97.7513
270	73.8044	126.1906	270	88.7151	108.1319
315	69.8519	126.3337	315	88.5859	107.1669

M and M* are conjugate mirror points.

the mirror point has a strong dependence on the longitude. Also, $\theta_M + \theta_{M^*}$ is not equal to 180° , unlike the dipole case. The curves indicate that the distribution of θ_M with respect to the longitude has a similar pattern for all values of α_0 .

The author's grateful thanks are due to Dr. K. S. Viswanathan for his valuable guidance in preparing this paper, to Sri. S. Janardhan for helpful suggestions during computation and to the Director for his kind permission to publish this paper.

1. Alfvén, *Cosmical Electrodynamics*.
2. Hamlin, D. A., et al., *J. Geophys. Res.*, 1961, **66**, 1.
3. Kern, J. W. and Vestine, E. W., *Space Science Reviews*, 1963, **2**, 136.

SEX-RATIO IN FISH POPULATIONS AS A FUNCTION OF SEXUAL DIFFERENCE IN GROWTH RATE

S. Z. QASIM

Biological Oceanography Division, National Institute of Oceanography (C.S.I.R.),
Ernakulam, South India

DURING a study of the biology of some fishes from the inland waters of India (Qayyum and Qasim, 1964), the sex-ratios in the population of various species were determined by taking regular monthly samples over a period of one year or more. It then appeared that in some species like *Ophicephalus punctatus*, males were in the majority, whereas in others, *Barbus stigma* and *Callichrous bimaculatus*, females outnumbered the males. Such differences in the sex-ratio remained unexplained until the growth rate of the two sexes in each species was examined.

Table I gives the total length frequencies of all the species under investigation. It can be seen from the table that in *O. punctatus*, the males attain a size larger than the females. This was further confirmed by a study of the growth rate of the fish from opercular bones and scales (Qasim and Bhatt, 1966). In *B. stigma* and *C. bimaculatus*, on the other hand, the females grow bigger than the males. Since no reliable method of age determination in these two species could be found out, this inference was drawn by a study of the length frequency distribution alone. In *B. stigma* which attains a maximum size of 13.0 cm., fishes larger than 10.0 cm. were all females and the same was true in *C. bimaculatus* where all fishes larger than 26.0 cm. were females (Table I).

It therefore seems that the preponderance of one sex in the population is because of the sexual difference in growth rate. Faster growth

TABLE I
Length frequencies and sex-ratios in three different freshwater fish populations of India

Species	<i>Ophicephalus punctatus</i>		<i>Barbus stigma</i>		<i>Callichrous bimaculatus</i>	
	Males	Females	Males	Females	Males	Females
Length groups cm.						
3.0	..	..	12	19	..	..
4.0	..	..	31	28	..	..
5.0	33	29	12	19	..	..
6.0	23	29	28	25	..	..
7.0	33	26	30	33	2	1
8.0	38	23	96	68	5	1
9.0	74	74	34	118	16	12
10.0	75	59	7	47	24	33
11.0	58	49	..	21	35	56
12.0	53	44	..	5	31	49
13.0	54	57	..	1	24	46
14.0	53	59	..	..	29	50
15.0	55	57	..	..	41	43
16.0	30	42	..	..	27	37
17.0	32	25	..	..	26	30
18.0	19	17	..	..	19	24
19.0	18	20	..	..	16	17
20.0	23	6	..	..	13	21
21.0	17	6	..	..	12	17
22.0	11	9	..	..	11	24
23.0	21	6	..	..	7	16
24.0	13	1	..	..	5	14
25.0	14	..	..	..	2	10
26.0	10	..	..	..	4	12
27.0	5	..	..	..	..	10
28.0	2	..	..	..	..	12
29.0	3	..	..	..	..	..
Total	772	638	250	384	349	535
Sex ratio	1 : 0.82		1 : 1.5		1 : 1.5	

probably leads to increasingly less effect from predation and this may influence the sex-ratio in favour of the sex growing faster. It may further affect the sex-ratio through other extrinsic factors beside predation, for the existence of a size hierarchy in the population will favour the large-sized individuals in both intra and interspecific competition for food and space. In other words, it seems that survival is a function of length.

To test this hypothesis the sex-ratios and the growth of each sex of some of the marine and freshwater fishes for which data are available were compared (Table II). The basis of comparison has been to include the concept of sex-ratio in the picture outlined by Beverton and Holt (1959). The various parameters worked

maximum asymptotic length and K is a constant.

The other parameters in Table II are:

M = coefficient of mortality

$T_{max.}$ = the maximum recorded age of the species

L_m = the average length at maturity

L_m/L_∞ = the ratio between the size at first maturity and asymptotic length.

It will be seen from Table II that in each species L_∞ shows definite trends and points directly towards the preponderance of sexual numbers in the population. The only species which seems to fall out from this generalisation is the bullhead, *Cottus gobio* where perhaps the L_∞ between the two sexes does not differ significantly to affect the sex-ratio and presumably for this reason, in the two samples

TABLE II

Data on growth, sex-ratio and other related parameters of some marine and freshwater fish populations

Species	Common name	Locality	Author	Sex	L_∞ (cm.)	K	M	$T_{max.}$ (sample)	L_m (cm.)	L_m/L_∞	Sex-ratio m : f
<i>Pleuronectes platessa</i>	Plaice	North Sea	Beverton and Holt (1959)	m	45	0.15	0.22	13	25	0.56	1 : 1.115*
				f	70	0.08	0.12	22	28	0.40	
<i>Calionymus lyra</i>	Dragonet	English Channel	Chang (1951)	m	25.0	0.43	0.96	4	17.4	0.70	1 : 0.58
				f	17.5	0.55	0.86	6	..	..
<i>Cottus gobio</i>	Bullhead	Windermere R. Brathay	Smyly (1957)	m	7.2	0.7	1.1	4	4.6	0.64	1 : 0.88
				f	7.3	0.4	0.9	6	4.2	0.58	
				m	6.5	0.9	0.9	4	≈ 5	≈ 0.77	1 : 1.60
				f	6.5	0.5	0.8	6	≈ 5	≈ 0.77	
<i>Blennius pholis</i>	Blenny	Welsh Coast	Qasim (1957a)	m	17.2	0.28	1.15	6	8	0.47	1 : 1.07
				f	16.8	0.33	0.96	6	8	0.47	
<i>Gadus minutus</i>	Poorcod	English Channel	Menon (1950)	m	20	0.42	1.1	5	11	0.55	1 : 1.80
				f	24	0.40	0.9	5	13	0.54	
<i>Centronotus gunnellus</i>	Butterfish	Welsh Coast	Qasim (1957b)	m	18.9	0.35	1.52	6	9	0.48	1 : 1.19
				f	18.4	0.42	1.91	6	9	0.49	
<i>Ophicephalus punctatus</i>	Murrel	Aligarh ponds, India	Qasim and Bhatt (1966)	m	32.3	0.20	0.75	7	11	0.33	1 : 0.82
				f	21.2	0.45	1.24	7	11	0.51	
<i>Oncorhynchus keta</i>	Chum-salmon	Columbia R., Canada	Marr (1943)	(m	120	0.27	(3.0)	5	81	0.68	1 : 0.84
				f	105	0.30			75	0.72	
				(m	106	0.45	(1.2)	5	75	0.72	1 : 0.96
				f	102	0.39			70	0.69	
		4-year Spawners									
		3-year Spawners									

* Values based on data given by Graham (1956).

out by these authors have been kept the same and in some species where it was found necessary, these parameters were calculated according to the methods suggested by these authors (see Beverton and Holt, 1956, 1957 and 1959). These parameters are based on the well-discussed exponential equation of von Bertalanffy which in its simplest form reads:

$$l_t = L_\infty (1 - e^{-kt})$$

where l_t is the length at age t , L_∞ is the

examined by Smyly (1957), the sex-ratio seems to work either way. In some of the other species indicated in Table II, females are larger and more abundant in the population. In *O. punctatus* and *O. keta*, males are more abundant and they grow significantly larger also.

As a general rule it might be expected that a greater increase in size is directly associated with a greater longevity of one sex and consequently the parameter $T_{max.}$ would affect the

sex-ratio of the population more directly than L_{∞} . However, a close examination of Table II will reveal that this is not always true as when T_{max} in the two sexes is the same, one would expect both sexes to occur in fairly equal numbers in the population. On the contrary, in those species (*B. pholis* and *C. gunnellus*) where T_{max} in both sexes has been found to be the same, there is a clear difference in their sex-ratio. This seems mainly associated with the sexual difference in L_{∞} , and indeed in those species (*B. pholis* and *C. gunnellus*) where L_{∞} does not differ or only differs slightly, both sexes occur in fairly equal numbers (Table II). The very interesting example is that of *C. lyra* where males are short-lived yet larger and more abundant in the population.

However, in most cases a greater increase in length of one sex is associated with a greater longevity, i.e., a higher T_{max} (see Table I, Beverton and Holt, 1959). This may in itself be due to the influence of intrinsic factors upon the individuals of the population. Faster growing sex may be that which is better adapted physiologically and thus the intrinsic factors will also affect the sex-ratio in favour of the sex growing faster.

That the survival is a function of length is further confirmed in each species by the inverse relationship traced by Beverton and Holt (1959) between L_{∞} and K and a direct association between M and K. Since K is closely related to metabolic rate of the fish (see Beverton and Holt, 1957 and 1959), it is evident that a higher K of any one sex will lead to an increase in M. In other words, M will be less when L_{∞} is greater. The only exceptions to this rule seem to be the dragonet, *C. lyra* and the three-year spawners of the chum salmon, *O. keta* (Table II). In the former case the males have a lower K and a higher M and in the latter a higher K is associated with a higher L_{∞} in males. The case of *C. lyra* may be considered as exceptional and extreme because the life of the males comes to an abrupt end soon after spawning (Chang, 1951), and for this reason M is higher. No explanation could however be found for the

association of a higher K with a higher L_{∞} in males of the three-year spawners of *O. keta*.

Another interesting feature which emerges from the analysis of these data is the relationship between L_m/L_{∞} and M. Generally a higher L_m/L_{∞} is associated with a lower L_{∞} and a higher M, and the statement of Beverton and Holt (1959) that short-lived species are those which have a higher L_m/L_{∞} , seems to be true among the two sexes of the same species also. Probably a greater mortality of one sex, be it male or female, is because of increased metabolic strain of reproduction for they mature at a size which is relatively larger in relation to their L_{∞} . This would also account for the sexual difference in the asymptotic length.

The author wishes to thank Dr. N. K. Panikkar, Director, National Institute of Oceanography (C.S.I.R.), for his interest and encouragement, and Mr. K. Srinivasa Rao for his help in statistical calculations.

1. Beverton, R. J. H. and Holt, S. J., in *Sea Fisheries—Their Investigation in the United Kingdom*, Edward Arnold Ltd., London, 1956 a, p. 372.
2. — and —, *Rasp. Cons. Explor. Mer.*, 1956 b, **140**, 67.
3. — and — *Fish Invest., Lond.* 1957, **19**, 1.
4. — and —, in *The Lifespan of Animals. Ciba Found. Colloq. on Ageing*, Edited by Wolstenholme, G. E. W. and O'Connor, M., 1959, **5**, 142.
5. Chang, H. W., *J. mar. biol. Ass. U.K.*, 1951, **30**, 281.
6. Graham, M. in *Sea Fisheries—their Investigation in the United Kingdom*, Edward Arnold Ltd., London, 1956, p. 332.
7. Marr, J. C., *Stauf. ichthyol. Bull.*, 1943, **2**, 157.
8. Menon, M. D., *J. mar. biol. Ass. U.K.*, 1950, **29**, 185.
9. Qasim, S. Z., *Proc. zool. Soc. Lond.*, 1957 a, **128**, 161.
10. —, *J. Anim. Ecol.*, 1957 b, **26**, 389.
11. Qayyum, A. and Qasim, S. Z., *J. Bombay nat. Hist. Soc.*, 1964, **61** (1), 74-98 (2), 330-347 (3), 627.
12. Qasim, S. Z. and Bhatt, V. S., *Hydrobiologia*, 1966 (In press).
13. Smyly, W. J. P., *Proc. zool. Soc. Lond.*, 1957, **128**, 431.

BREEDING POTATO VARIETIES TOLERANT TO HIGHER THERMOPERIODS

M. L. KHANNA

Central Potato Research Institute, Simla-1

THE life-cycle of potato can be divided into three distinct phases of germination, growth and tuberisation; the later two being directly responsible for yield. In potato crop husbandry, among the different environmental factors the photoperiod and temperature are more important and these interact in their effects upon growth and development.

Out of these two factors the photoperiod effects can be easily controlled by cultivating known potato varieties adapted to the required photoperiod. But it is not so yet with effect of temperature. However, it has been observed that the potato crop gives maximum yield under the temperature range of 15° C to 18° C and after that there is progressive reduction in tuberisation upto 30° C beyond which no tubers are formed.¹⁻³

In India 90% of the total area under potato is in the plains. An examination of the prevalent temperatures in the potato growing regions during the growth and tuberisation of the potato crop shows that there is a relative decrease in yield in the areas where the period having the optimum temperature conducive for tuberisation and growth is short. Based on this observation the plain regions of India can be divided into four major zones as detailed below:

hectare yield can be increased by evolving such varieties in which seed potatoes can stand high temperature in field to ensure good germination and can tuberise under higher temperature thus giving longer period of growth and tuberisation to potato crop.

To introduce potato cultivation in areas indicated in Zone 4, there will be a need for evolving varieties which can germinate well, complete their growth phase and tuberise under prevailing higher temperatures of 30° C or more. The varieties adapted to this region will not only help in introducing potato cultivation in regions where the yield is very low but also in the areas where potato cultivation at present is not at all possible. Such varieties may further extend the scope for potato cultivation in other parts of S.E. Asia where the conditions are similar to Zone 4.

The present paper is a preliminary report on breeding potato varieties suitable for Zone 4.

Materials and Method.—519 selections, possessing desirable agronomic characters, from the progeny of 12 crosses involving 15 parents some of which had been observed to have early maturity and adaptability to tolerate higher temperature, were selected for screening for tolerance to high temperature for the germi-

Zone	Crop period	No. of days conducive for growth and tuberisation	Yield behaviour
1. Punjab, Jammu, part of Rajasthan and Western U.P.	Early October to March	150 days	Region of highest yield
2. Eastern U.P., Northern Bihar, Orissa, East Bengal and Madhya Pradesh	Early November to February	100-110 days	Region of moderate yield
3. South Bihar and Plateau regions of Maharashtra, Andhra Pradesh and Madras	November to February (under prevailing higher temperature) and rainy season crop between June and September	80-90 days	Region of low yield
4. South India plains	..	20-40	Region where cultivation is not possible

For Zone 1, the improvement in varietal pattern can still be made by evolving frost resistant types but for Zones 2 and 3 per

nation and the growth phases. The clonal populations of these selections and the control variety Kufri Red raised in pots were kept in

a glass-house at the day temperature of 45° C and night temperature of 30° C for 15 days. The effect of treatment on the foliage was visible from the 9th day when Kufri Red a commercial variety used as control developed severe wilting and died. The selections were grouped in three grades depending on the number of days taken by them to dry and get killed by this treatment, i.e., susceptible (dried within 11 days), moderately tolerant (dried between 12-15 days) and highly tolerant (no drying till 15 days) (Table I).

TABLE I
Testing of crossbred progenies of potato varieties for tolerance to high temperature conditions

Parentage	No. of selections tested	No. highly tolerant	No. moderately tolerant	Susceptible
1. Gladstone × K. Kundan	.. 5	1	1	3
2. Majestic × K. Kundan	.. 70	..	11	59
3. Gladstone × Taborky	.. 59	3	8	48
4. K. Kundan × Gigantic	.. 10	4	..	6
5. President × Taborky	.. 15	4	2	9
6. McKelvey's seedlings 25/823 × Krasava	13	..	3	10
7. President × Gigantic	.. 60	..	14	46
8. Red King × Gigantic	.. 12	8	1	3
9. US seedling 41956 × Gigantic	8	..	..	8
10. CPS 1708 × Hyb. 12	.. 9	1	..	8
11. Red skin × Krasava	.. 200	10	17	173
12. Majestic × Hyb. 13	.. 58	12	12	34
TOTAL	.. 519	43	69	397

Thereafter the plants showing moderate and high tolerance were allowed to tuberise under normal temperature. These selections (total 112 designated as H.B. series) were later

sent for field assessment for yield at Patna in Bihar. Out of these the ones which gave better yield than control (Kufri Red) were sent for field trials at Coimbatore where the mean maximum temperature during tuberisation phase is 29° C.

Results.—The results of the field trial conducted with 112 heat tolerant selections at Patna planted in early October (when the temperature is not conducive to normal germination), showed that these gave 90-95% germination, and out of these 13 selections yielded more than control. In the field trial conducted at Central Farm, Coimbatore, with the first ten out of the 13 clones selected at Patna three, viz., HB.1699, HB.887 and HB.783 yielded 3915 kg./acre, 1740 kg./acre and 1666 kg./acre (control Up-to-Date yielded 809 kg./acre).

The conclusion arrived at by the above study was that ability to tolerate high temperature seems to be heritable in potato and the degree of tolerance could be increased by sibmating and intercrossing between elite lines and proper selection. Further work on these lines is in progress and at present a sizable population of selections possessing still higher tolerance to high temperature and good yielding potential, are under field trials at Patna and Coimbatore.

The investigations made further revealed that there was association between high temperature tolerance and resistance to charcoal rot (incited by *Machrophoma phaseoli*), a disease of the zones where potato is cultivated under higher temperature.⁴ Out of the selections reported here HB.836, HB.1256 and HB.1313 possess resistance to charcoal rot.

1. Bushnell, J., *Techn. Bull. Min. Agric. Expt. Sta.*, 1925, **34**, 29.
2. Werner, H. O., *J. Agric. Res.*, 1940, **61**, 761.
3. Burton, W. G., *Proc. I. Triennial Conf. E.A.P.R.* 1960 Wageningen, 1961, p. 79.
4. Paharia, K. D., *Indian Potato J.*, 1960, **2**, 1.

LETTERS TO THE EDITOR

EMISSION SPECTRUM OF *m*-FLUOROANILINE IN THE NEAR ULTRAVIOLET REGION

m-FLUOROANILINE molecule is obtained by replacing two hydrogen atoms of benzene ring by NH_2 group and fluorine atom in one and three positions respectively. The electronic absorption spectrum of this molecule in cyclohexane solution has been studied by Forbes and Leckie.¹ Interpolated Raman data have been given by Kohlrausch.² Thompson³ included this molecule along with other substituted anilines to calculate the vibrational band intensities. The absorption spectrum of *m*-fluoroaniline in vapour phase has been studied by us.⁴ Also the near ultraviolet absorption spectra of isomeric fluoroanilines in vapour phase have been reported.⁵ The present note is concerned with the emission spectrum of *m*-fluoroaniline and the vibrational analysis of the observed bands.

The emission spectrum of *m*-fluoroaniline has been photographed on medium quartz spectrograph. An uncondensed transformer discharge was used to excite the molecule. The emission spectrum was recorded on N. 40 Ilford plates in 3 to 5 hours with a slit width of 30 microns. The length of the discharge tube was 50 cm. having a diameter of 2.4 cm. The discharge tube was of π type. About 4000 volts were applied to excite the molecule. The colour of the discharge was pinkish-blue.

The emission spectrum lies in the region 3158–2824 Å. About 45 bands have been measured and analysed in terms of ten ground state and two excited state frequencies. The bands are sharp and degraded towards red. The (0-0) band of the system has been identified at 34612 cm^{-1} with a weak intensity due to self absorption by unexcited vapour of the substance. The position of the (0-0) band agrees well with the absorption spectrum.

If NH_2 be taken as a single mass point in *m*-fluoroaniline then this molecule may be put in C_s point group. In this point group the plane of the molecule is the only element of the symmetry. Forbidden ${}^1A_{1g} \rightarrow {}^1B_{2u}$ transition in D_{6h} point group to which benzene belongs, corresponds to an allowed ${}^1A' \rightarrow {}^1A'$ transition in C_s point group.

The whole spectrum has been analysed in terms of 242, 417, 507, 611, 740, 847, 1000, 1043, 1165 and 1270 cm^{-1} ground state and 285

and 770 cm^{-1} excited state frequencies. The fundamental vibration frequencies obtained in emission spectrum are given in Table I.

TABLE I
Fundamental vibration frequencies of
m-fluoroaniline

Raman effect Kohlrausch (cm^{-1})		Infrared (cm^{-1}) (present work)	Emission spectrum	
			Ground State frequencies (cm^{-1})	Excited State frequencies (cm^{-1})
220 (dp) mst	..	..
240 (dp) mst	..	..	242	
350 (p) m	..	..	417	285
530 (p) st	..	..	507	..
515 (dp) m	..	..	..	..
605 (dp) m	..	..	611	..
740 (p) st	..	..	740	..
..	..	..	847	770
950 (ss)	..	951 (ms)	..	..
1000 (p) sst	..	1005 (s)	1000	..
..	..	..	1165	..
1298 (p) st	..	1280 (s)	1270	..
1590 (p, dp) m	..	1600 (s)	..	..

The author is grateful to Prof. Nand Lal Singh for his continued interest in the work and N.B.S. for financial assistance.

Department of Spectroscopy, P. K. VERMA.
Banaras Hindu University,
Varanasi-5, December 27, 1965.

1. Forbes, W. F. and Leckie, I. R., *Can. J. Chem.*, 1958, **36**, 1371.
2. Kohlrausch, K. W. F., *Monatsch*, 1947, **76**, 249.
3. Thompson, H. W., Krueger, P. J., *Proc. Roy. Soc., (London)*, 1957 **244 A**, 143.
4. Singh, N. L. and Verma, P. K., *Ind. J. Pure and Appl. Phys.*, 1965, **3**, 176.
5. Sashidhar, M. A. and Suryanarayana Rao, K., *Curr. Sci.*, 1965, **34** (16), 478.

URANYL ION-ITACONIC ACID COMPLEX

DETAILED studies on Uranyl ion-Itaconic acid complex have not been reported so far except those by Tsai-Teh Lai and Bi-cheng Wang¹ who have concluded formation of 1:1 and 1:2 complexes as well as their polymers in a polarographic study in the pH range 2 to 4. We have followed the titration of uranyl perchlorate—itaconic acid—perchloric acid—sodium perchlorate system at an ionic strength of 0.1 and at 28° C. against standard sodium hydroxide solution with a view to determine the number and stability constants and polymerizing

tendencies of the complexes of UO_2^{++} -itaconic acid, from pH titration data. The chemicals employed were all of AnalaR grade and Leeds and Northrup pH meter (Cat. 7666) with glass and calomel electrodes was employed for pH measurements. Data of pH > 3.5 in which hydroxy complexes intervene were not considered. The amount of ligand (itaconic acid) bound to the uranyl ion was calculated from pH data and values for Bjerrum's formation function, \bar{n} , were plotted against log of reciprocal free ligand concentration ($-\log A$). The required first and second dissociation constants of itaconic acid were determined by the standard slope and intercept method.² The stability constant of the 1:1 complex was also calculated from the relation:

$$K_1 = (T_m - [A]x) / [A]^2 x$$

in which T_m = total metal ion concentration and 'x' is a function of first and second dissociation constants of itaconic acid and $[\text{H}^+]$. The titration was carried out when the total metal ion or ligand concentrations in 1:1 molar ratio were $2 \times 10^{-2} \text{ M}$; $3.2 \times 10^{-3} \text{ M}$ and $1.6 \times 10^{-3} \text{ M}$.

We conclude from our results that (i) Uranyl ion-itaconic acid complex (1:1) is formed and $K_1 = 4.849$ from \bar{n} vs. $-\log A$ plot and $K_1 = 4.9 \pm 0.05$ from calculation; (ii) In the pH range, 2.2-3.5 and for concentrations of metal ions, $3.2 \times 10^{-3} \text{ M}$ and $1.6 \times 10^{-3} \text{ M}$, \bar{n} values do not go beyond 0.4 and 0.3 respectively and K_1 calculated at these concentrations are 4.58 and 4.73 respectively; (iii) The trend of K_1 values with changes in concentrations of metal ion ligand does not warrant any conclusion with regard to polymerization of the complexes; (iv) The slope ratio method yields $\text{p}K_1 = 3.61$ and $\text{p}K_2 = 5.075$ (cf. $\text{p}K_1 = 3.68$ and $\text{p}K_2 = 5.14$)³ for itaconic acid.

Dept. of Physical Chem., S. RAMAMOORTHY.
University of Madras, M. SANTAPPA.
A.C. College of Technology
Buildings,
Madras-25, November 15, 1965.

1. Tsai-Teh Lai and Bi-cheng Wang, *Anal. Chem.*, 1964, **36**, 26.
2. Irwing, H. and Rosotti, H. S., *J. Chem. Soc.*, 1953, p. 3397.
Rosotti, F. J. C. and Rosotti, H. S., *Acta Chem. Scand.*, 1955, **9**, 1166.
3. Motoo Yasuda, Kayuo Yamasaki and Hitoshi Ohtaki, *Bull. Chem. Soc. Japan*, 1960, **33**, 1067.

CHEMICAL EXAMINATION OF COUROUPITA GUIANENSIS AUBL.

THE identification of α and β -amyrins and β -sitosterol in the bark of *Couroupita guianensis* is described.

Couroupita guianensis Aubl. (Fam. *Lecythidaceae*) is commonly known as Cannon-ball tree, as its fruit resembles a Cannon-ball (Dia. 5-7"). Earlier workers¹ reported carotenoids, citric acid, malic acid, isocitric acid and a phenolic substance from the fruit of a South American tree. Recently, Lewis² showed that the rose red flowers contain pelargonidin glycosides and three flavanol glycosides of quercetin and k  mpferol, all identified by paper chromatography. The author further records that blue colour of bruised flowers is due to indigotin.

In view of a local therapeutic reputation of the leaves as a cure for skin diseases, the bark (1.8 kg.) was investigated for its chemical constituents. The ether extract of the bark contained α -amyrin [m.p. 186-87°; (α)_D³⁰ + 90°], β -amyrin [m.p. 197°; (α)_D³⁰ + 88°], β -sitosterol [m.p. 136-37°; (α)_D³⁰ - 37°] and an unknown plant alcohol (m.p. 101-03°). Their separation was effected by chromatography on an alumina column (37 x 5 cm.). Table I below gives the details of eluants and the compounds isolated.

TABLE I

S. No.	Eluant	Crystalline compounds (g)	m.p. °	Name of the compounds
1	Light petroleum (1 l)	2.70	161-76	α and β -amyrins
2	Benzene-petroleum ether (1:1; 450 ml.)	0.09	196-97	β amyrin
3	Benzene (500 ml.)	..	136-37	β -sitosterol
4	Benzene-ether (3:1; 300 ml.)	0.06	101-03	Plant alcohol
5	Ether (200 ml.)	..	203-04	Triterpene alcohol (unidentified).
6	Ether-methanol (1:1; 1 l.)	..	..	Nil
7	Methanol	..	..	Nil

The mixture of α and β -amyrins from the first eluant was effectively separated through their benzoates by fractional crystallisation following the method of Musgrave and Wagner.³ All the compounds and their derivatives analysed satisfactorily.

The alcoholic extract of the bark contained tannins but no other crystalline solid.

L. RAMACHANDRA ROW.

Dept. of Chemistry, C. S. PRAKASA SASTRY.
Andhra University, P. SURYANARAYANA MURTHY.
Waltair, October 30, 1965.

1. Nelson, E. K. and Wheeler, D. H., *J. Am. Chem. Soc.*, 1937, **59**, 2499.
2. Lewis, Y. S., *Curr. Sci.*, 1964, **33**, 682.
3. Musgrave, O. C. and Wagner, H. M., *J. Chem. Soc.*, 1952, p. 2937.

CHEMICAL COMPONENTS OF *LOBARIA SUBSIDIOSA*, *L. RETIGERA* AND *L. SUBRETIGERA* FROM THE WESTERN HIMALAYAS

THE chemical components of a few *Lobaria* lichens of Indian origin were reported in our earlier publications.¹⁻³ In continuation, we have examined samples of *L. subsidiosa*, *L. retigera* and *L. subretigera* collected from the Western Himalayas and the results are reported in the present communication. The extraction procedure was the same as described by Aghoramurthy *et al.*,⁴ and the powdered lichen samples were extracted exhaustively in a Soxhlet with light petroleum, ether and acetone in succession. Each extract was worked up separately and the identity of the known compounds was established by direct comparison with authentic samples obtained earlier from the lichens.

L. subsidiosa (Asah.) collected near Ganghariya (10,000 ft.) in the Chamoli district from the pine trees gave wax and carotenoids in its light petroleum extract. Its ether extract contained stictic acid (0.53%), m.p. 265-7°d., along with traces of norstictic acid, the presence

of which was shown by thin layer chromatography on silicagel-G according to the procedure of Pastuska⁵ and Ramaut.⁶ Acetone extract of the lichen was worked up as described earlier³ and gave traces of thelephoric acid, stictic acid (0.17%), traces of norstictic acid (TLC) and D-arabitol.

L. retigera (Bory.) Trev. sample was collected from the oak trees near Sukhital (10,000 ft.) in the Kumaon Himalayas. While only wax and carotenoids were obtained on chromatography of the light petroleum extract of this lichen, its ether extract gave a good yield (1.36%) of the colourless triterpene acid, compound-D,³ m.p. 289-91°, $[\alpha]_D^{25} + 20^\circ$ (C, 1.0 in pyridine) besides stictic acid (0.044%). The acetone extract gave thelephoric acid (0.053%), stictic acid (0.062%) and D-arabitol (0.018%) and D-mannitol (traces).

Three samples of *L. subretigera* collected from the Hemkund-Lokpal region, Valley of Flowers and Ganghariya were separately examined and gave similar results. The light petroleum extract in each case was fractionally crystallised to get retigeradiol designated earlier as compound-A and retigeranic acid, earlier recorded as compound-B. Retigeradiol has now been shown to be a saturated pentacyclic dissecondary diol of the triterpene series believed to be a taraxerane derivative while retigeranic acid is a tetracyclic α, β -unsaturated terpenic acid. The ether extract gave in each case besides the triterpene acid designated compound-D, a mixture of stictic and norstictic acids, the latter however occurring only in traces. Acetone extract in each case gave thelephoric acid, stictic acid, traces of norstictic acid and the

TABLE I
Chemical components of *L. subretigera* Inumaru collected in 1964

Place of collection	Light petroleum extract	Ether extract	Acetone extract
1 Hemkund-Lokpal ..	1 Retigeradiol (0.196%) 2 Retigeranic acid (2.84%)	1 Compound-D (0.25%) 2 Stictic acid (0.06%) 3 Norstictic acid*	1 Thelephoric acid (0.3%) 2 Stictic acid (0.12%) 3 Norstictic acid* 4 D-Mannitol (0.014%) 5 Arabitol†
2 Ganghariya ..	1 Retigeradiol (0.15%) 2 Retigeranic acid (1.12%)	1 Compound-D (0.11%) 2 Stictic acid (0.33%) 3 Norstictic acid*	1 Thelephoric acid (0.283%) 2 D-Arabitol (0.056%) 3 Mannitol†
3 Valley of Flowers ..	1 Retigeradiol (0.01%) 2 Retigeranic acid (0.03%)	1 Compound-D (0.12%) 2 Stictic acid (0.13%) 3 Norstictic acid*	1 Thelephoric acid (0.028%) 2 Stictic acid (0.3%) 3 Norstictic acid* 4 D-Arabitol (0.022%)

* Identified by thin layer chromatography.

† Identified paper chromatographically.

sugar alcohols, D-arabitol and mannitol either individually or together. The sample from Ganghariya did not give stictic acid and norstictic acid in its acetone extract. The yields of the various components were different with each of the samples and are recorded in Table I.

From the chemical study of the *Lobaria* lichens, a few significant features are discernible. All the *Lobaria* lichens contain the β -orcinol depsidone stictic acid, along with the *p*-terphenyl quinone pigment, thelephoric acid though the relative proportions are varying. In addition to these, terpenic compounds and sugar alcohols are also present in these lichens but are not uniformly distributed. *L. isidiosa* and *L. subsidiosa* differ in that the former contains the terpenic compound-D while the latter is devoid of terpenic compounds. Thelephoric acid occurs only in traces in *L. subsidiosa*. A further clear cut distinction is possible between these two lichens because of the presence of norstictic acid only in the subspecies. Ramakrishnan and Sankarasubramanian⁷ have recorded a difference in the amino-acid distribution pattern in these two lichens. *L. retigera* contains the terpenic compounds, retigeradiol and retigeranic acid in addition to compound-D, while *L. isidiosa* contains only compound-D and this makes it possible to distinguish between the two main species. *L. retigera* and *L. subretigera* contain the same terpenic compounds the main difference between the two being the presence of norstictic acid in the latter.

A detailed account of the structures of retigeradiol, retigeranic acid and compound-D will be published elsewhere.

ACKNOWLEDGEMENTS

We wish to convey thanks to Dr. Mason E. Hale of the Smithsonian Institution, Washington, for identification of lichens described in this communication.

Department of Chemistry,	P. S. RAO.
University of Delhi,	K. G. SARMA.
Delhi-7, December 9, 1965.	T. R. SESHADRI.

1. Seshadri, T. R., *Ind. J. Pharm.*, 1953, **15**, 286.
2. Aggarwal, S. C., Aghoramurthy, K., Sarma, K. G. and Seshadri, T. R., *J. Sci. Industr. Res.*, 1961, **20 B**, 613.
3. Rao, P. S., Sarma, K. G. and Seshadri, T. R., *Curr. Sci.*, 1965, **34**, 9.
4. Aghoramurthy, K., Sarma, K. G. and Seshadri, T. R., *J. Sci. Industr. Res.*, 1961, **20 B**, 166.
5. Pastuska, G., *Z. Anal. Chem.*, 1962, **179**, 356.
6. Ramaut, J. L., *Bull. Soc. Chem. Belg.*, 1963, **72**, 97, 216.
7. Ramakrishnan, S. and Sankarasubramanian, S., *Curr. Sci.*, Under publication.

CHEMICAL INVESTIGATION OF *ENICOSTEMMA LITTORALE*, BLUME

Enicostemma littorale, Blume (Gentianaceae) is a perennial herb found throughout the greater part of India, more frequently near the sea. It is a very bitter plant and is used in indigenous medicine in the treatment of fevers and as a bitter tonic.¹ A crystalline alkaloid ($C_{10}H_9O_2N$, m.p. 82-83°) was isolated from the plant by Sita Rama Iyer *et al.*² They found it identical with the alkaloid Gentianine, first isolated from *Gentiana Kirilowi* by Proskurnina.³

The present authors have obtained three more compounds from the plant by successive extractions with ether and ethanol. The green viscous mass obtained from the alcoholic extract on treatment with ether to remove chlorophyll and other impurities was treated with ethyl acetate. The ethyl acetate soluble portion yielded an extremely bitter, pale yellow, amorphous substance. This product gave reactions characteristic of glycosides. It melted at 108-11° (starts to shrink from 70°). It was identified as Swertiamarin⁴ by preparation of its acetate,⁴ m.p. 193-94°, $[\alpha]_D = -101^\circ$ and the conversion of its acetate into Gentianine⁵ confirmed by m.m.p. determination with an authentic sample.

The ethyl acetate insoluble portion, after crystallisation from ethyl alcohol, yielded a non-bitter white crystalline compound, m.p. 224-26°. This compound is being studied further.

The dark green, waxy substance obtained from the original ethereal solution was saponified with 5% alcoholic NaOH. The unsaponified matter yielded, on purification by chromatography over alumina, white crystalline plates, m.p. 252-54°. Acetate m.p. 214-15°. It gave reactions for a triterpene (Liebermann-Burchard reagent test, Noller reaction). It was found to be betulin by m.m.p. determination with an authentic sample of betulin 252-54° and its acetate m.p. 214-15°.

Both Swertiamarin as well as its acetate can be converted into the alkaloid Gentianine by treatment with ammonia.⁵ The previous workers had basified the powdered plant material with ammonia during the extraction of the alkaloid.² This leads us to suspect that the alkaloid was not present as such in the plant, but was produced during the course of extraction.

The physiological activity of the bitter compound is being studied.

The authors wish to express their thanks to Dr. B. C. Pathak, University Colleges of Science and Technology, Calcutta, for supplying an authentic sample of the alkaloid gentianine and

to the authorities of the Marathwada University for a grant of a fellowship to one of them (J. R.).

Department of Chemistry, JAGMOHAN RAI.
Marathwada University, K. A. THAKAR.
Aurangabad, September 30, 1965.

1. *The Wealth of India, Raw Materials*, D.S.I.R., New Delhi, 1948, 2, 174.
2. Sita Ram Iyer, R., Pathak, B. and Ajay Bose, K., *Naturwissenschaften*, 1956, 43, 251.
3. Proskurnina, N. F., *J. Gen. Chem. U.S.S.R.*, 1944, 14, 1148.
4. Takashi Kubota and Yutaka Tomita, *Chem. and Ind.*, 1953, p. 229.
5. — and —, *Tetrahedron Letters*, 1961, p. 453.

SYNTHESIS OF SOME SUBSTITUTED 2-(2-FURYL) CHROMONES BY THE SIMPLIFIED BAKER-VENKATARAMAN TRANSFORMATION

The synthesis of 2-heterocyclic substituted chromones is becoming increasingly important, in view of their pronounced physiological activity. Devitt, Timoney and Vickers¹ prepared a number of 2-(2-furyl), 2-(2-thienyl), and 2-(3-pyridyl) chromones, and found them to possess antitumor and cardiovascular activity. They made use of Baker-Venkataraman transformation for the synthesis of the above chromones by preparing at first the β -diketones employing potassium hydroxide in pyridine, and cyclising them later to chromones.

It was reported^{2,3} that 2-phenyl chromones could be formed directly from 2-hydroxy acetophenones and aromatic acid chlorides by using potassium carbonate in acetone. Further, it was observed that the simplified Baker-Venkataraman transformation is applicable to 2-hydroxy- ω -substituted and 2:6-dihydroxy acetophenones.²⁻⁴

Adopting the simplified Baker-Venkataraman method, a number of substituted 2-(2-furyl) chromones have now been synthesised by condensing 2-hydroxy, 2-hydroxy- ω -methyl, 2-hydroxy- ω -phenyl and 2:6-dihydroxy acetophenones with furoyl chloride and potassium

carbonate in acetone. The products formed are given in Table I.

From the Table, it is evident that only in the case of 2:4-dihydroxy acetophenone β -diketone is formed, while in all other cases chromones have been obtained directly. The β -diketone could be cyclised and hydrolysed to 7-hydroxy-2-(2-furyl) chromone. It is interesting to note that with 2:6-dihydroxy acetophenone, 5-hydroxy-3-furoyl-2-(2-furyl) chromone was formed, which exhibits two peaks (1653 cm^{-1} and 1613 cm^{-1}) in the carbonyl region of the infra-red spectrum. The higher peak may be assigned to >C=O of furoyl

group, while the lower one to chromone carbonyl. In general, it may be concluded that an ω -substituent and a hydroxyl at 6 position in the 2-hydroxy acetophenone favour the direct formation of chromones, an observation made earlier in our laboratories in connection with the direct formation of 3-alkyl and 3-aryl flavones in the simplified Baker-Venkataraman transformation.⁶

One of the authors (A. V. S.) expresses his grateful thanks to the Government of India for the award of a scholarship.

Department of Chemistry, A. V. SUBBA RAO.
Osmania University, N. V. SUBBA RAO.
Hyderabad-7 (A.P.), December 8, 1965.

1. Devitt, P. F., Timoney, A. and Vickers, M. A., *J. Org. Chem.*, 1961, 26, 4944.
2. Gupta, V. N. and Seshadri, T. R., *J. Sci. and Ind. Res.*, 1957, 16 B, 116.
3. Jain, A. C., Mathur, S. K. and Seshadri, T. R., *Ibid.*, 1962, 21 B, 214.
4. Sreemannarayana, G. and Rao, N. V. S., *Curr. Sci.*, 1964, 33, 44.
5. Téoule, R., Gremier, G., Pacheco, H. and Chopin, J., *Bull. Soc. Chim. France*, 1961, 546; *C.A.*, 1961, 55, 15473.
6. Sreemannarayana, G. and Rao, N. V. S., Unpublished work, *Ph.D. Thesis*, (1965), Osmania University.

TABLE I

No.	Acetophenone	Product formed	M.P. (°C.)
1	2:4-dihydroxy	1-(2-hydroxy-4-furoyloxy phenyl)-3-(2-furyl) propane 1:3-dione	158
2	2:6-dihydroxy	5-hydroxy-3-furoyl-2-(2-furyl) chromone	169
3	2:4:6-trihydroxy	5:7-dihydroxy-2-(2-furyl) chromone	283 (lit 283 ⁵)
4	2:4-dihydroxy- ω -methyl	7-furoyloxy-3-methyl-2-(2-furyl) chromone	181
5	2:4-dihydroxy- ω -phenyl	7-hydroxy-3-methyl-2-(2-furyl) chromone	290-1
6	2:4:6-trihydroxy- ω -phenyl	7-hydroxy-3-phenyl 2-(2-furyl) chromone	231-2
		5:7-dihydroxy-3-phenyl-2-(2-furyl) chromone	254-5

TABLE I

Showing the mean value of measurements in micromillimetre of 100 Langerhans' cells and few of the smallest melanocytes from the black skin of the ear of guineapig

(Figures in parentheses represent the value of standard deviation)

Length of cell		Length of			Breadth of body	Thickness of		Number of dendritic processes
		Cell	Body	Dendritic process		Body	Dendritic process at the root at the tip	
Langerhans' cell	..	40.40 ± 0.48 (4.77)	8.38 ± 0.05 (4.49)	31.98 ± 0.20 (1.98)	6.36 ± 0.17 (1.72)	1	1 Fine	2.74 ± 0.20 (1.97)
Melanocyte	..	55	10	45	10	2	2 3	5

TABLE II

Showing in micromillimetre the average measurements of 25 Langerhans' cells each of Types I, II, III and IV prepared from the black skin the ear of the guineapig

(Figures in parentheses represent the value of standard deviation)

Length of the units measured (in micromillimetre)	Types of Langerhans' cells			
	I	II	III	IV
Cell	.. 46.56 ± 0.7 (1.36)	42.72 ± 0.23 (1.14)	39.52 ± 0.10 (0.51)	35.52 ± 0.10 (0.51)
Body	.. 9	8	7	7
Dendritic process	37.56 ± 0.27 (1.36)	34.72 ± 0.23 (1.14)	32.52 ± 0.10 (0.51)	28.04 ± 0.20 (0.98)

The high percentage of variation observed in the size of the Langerhans' cell as a class is appreciably reduced in the measurement of the individual types of the Langerhans' cell. Taking the Driesches⁷ Law of constant volume of cells into account, it can be inferred that the class of cells hitherto known as Langerhans' cell are actually composed of four types of cells now described as Types I, II, III and IV.⁸

Thanks are due to Mr. P. A. George for statistical analysis of the data. Mr. R. K. Saraut's technical assistance throughout the work is acknowledged.

Central Drug Research Institute, R. C. SHUKLA.
Chattar Manzil Palace, Lucknow,
October 19, 1965.

1. Pinkus, H., Starico, R. J., Krop, P. J. and Fan, J., *Proc. Conf. Biol., Normal and Atypical Pigment Cell Growth*, 1959, 4, 127.
2. Shukla, R. C., Karkun, J. N. and Mukerji, B., *Ind. Jour. Med. Res.*, 1954, 42, 125.

3. Birbeck, M. S., Breathnach, A. S. G. and Everall, J. D., *Jour. Invest. Dermat.*, 1951, 37, 51.
4. Medawar, P. B., *Nature (Lond.)*, 1941, 148, 491.
5. Shukla, R. C., Karkun, J. N. and Mukerji, B., *Curr. Sci.*, 1953, 22, 211.
6. — and Mukerji, B., *Ind. Jour. Med. Res.*, 1955, 43, 433.
7. De Robertis, E., Nowinski, W. W. and Saenz, E. A., *Gen. Cytology*, Saunders Co., 3rd Ed., 1963, p. 74.
8. Shukla, R. C., *Nature*, (in press).
9. —, Communicated to press.

ESSENTIAL OIL CONTENTS OF ROOT IN *BURSERA DELPECHIANA* POISS. EX ENGL., IN INDIA

THE wood (trunk) and fruits of *Bursera delpechiana* Poiss. ex Engl. on distillation yield 'Oil of Linaloe', used widely as fixative for high-grade perfumery and cosmetic products. This Mexican plant was introduced in India as early as 1912 and a sizable area is now coming up under its plantation in Mysore State. Subba Rao and Nagesa Rao¹ obtained the oil varying from 0.15 to 0.25% w./w. in foliage and 0.15% w./w. in flowers respectively. However, there is neither any description of the root system of Linaloe tree in literature nor any reference of presence or otherwise of the oil therein. Sastry² stressed the need for its investigation. This work was undertaken by the authors and the results are briefly summed up here.

Taproot is absent in trees examined by authors because the plantations are raised mostly from shoot cuttings.² Lateral roots are given by the underground central axis which extends 4 to 5 m. in length in old trees.¹ It is up to 2 cm. thick, brittle and light in weight. Epidermis greyish-brown, papery-thick peeling off in flakes in older roots, bark dull-brown 0.3 to 0.4 cm. thick. Wood light yellow and the ratio of bark to wood is about 40 : 60 by weight.

Distilling material was obtained from roots of over 30 years old tree. Bark and woods were separated from each other, dried, made into chips, and distilled each separately in Cocking and Middaeton's essential oil determining apparatus for 4-5 hours. The quantity of oil obtained on distillation is given in Table I.

TABLE I

Sample	Quantity	Total oil obtained	Percentage of oil
1. Root-wood ..	52 gm.	Nil	Nil
2. Root bark ..	35 gm.	0.0943 gm.	0.27 % w./w.

It may be seen that the wood is devoid of the oil; the oil obtained from the bark (root) possesses characteristic linaloe odour. It could not be examined physio-chemically because of a very small quantity. Further, the oil in the root-bark though higher in percentage than flowers or foliage, could not be developed into a commercial source because of the meagre root system in the Indian Linaloe trees.

We are grateful to Dr. M. N. Ramaswamy and Shri D. Rangegowda of our Bangalore Centre and Dr. S. C. Datta, Scientist-in-Charge of our organisation, for facilities in the work.

Central Indian Medicinal

RAJENDRA GUPTA.

Plants Organisation,

ROMA BANERJI.

Lucknow, September 2, 1965.

1. Gupta, Rajendra and Banerji, Roma, *Bom. Nat. Hist. Soc.*, 1965 (in press).
2. Rangegowda, D. and Ramaswamy, M. N., *Perf. Essent. Oil Rec.*, 1965, 56 (2), 85.
3. Sastry, S. G., *Indian (Mysore) Linaloe Oil—A Monograph*, Govt. Press, Bangalore, 1952.
4. Subba Rao, M. N. and Nagesa Rao, *Perf. Essent. Oil Rec.*, 1946, 37, 312.

A NOTE ON SOME HISTOCHEMICAL STAINING DIFFERENCES BETWEEN THE MYELINS OF THE CENTRAL AND THE PERIPHERAL NERVOUS TISSUES OF BIRDS

ALTHOUGH the biochemical and biological differences¹ between the myelins of the central and peripheral nervous tissues are on record the differences between the two myelins as seen in histochemically stained microscopic preparations are comparatively little known. Recently Singh² has reported the results of some histochemical reactions for lipids in avian central nervous tissues. A further study of these and some other histochemical reactions, viz., acid hæmatein test, controlled chromation method, copper phthalocyanin method (on paraffin sections of formalin fixed material) and

phosphomolybdic acid method,³ and periodic acid-Schiff (PAS) method,⁴ on the peripheral nervous tissues, e.g., spinal ganglia and sciatic nerves of two Indian birds, the parrot (*Psittacula krameri*) and the myna (*Acridotheres tristis*) and also of the rat, revealed some staining differences in their myelin from that of the central nervous tissues.²

The acid hæmatein staining of peripheral nervous tissues revealed that their myelin was not



FIGS. 1-2. Fig. 1. Section of the brain of rat showing PAS positive reaction in the myelin (indicated by arrow) of the fibres of a peripheral nerve trunk originating from within the brain (CT). Myelin in the fibres of the central nervous tissue (CT) is seen negative, $\times 100$. Fig. 2. Section of the brain of parrot (*Psittacula krameri*) showing positive PAS reaction in the myelin of the fibres of a peripheral nerve trunk (indicated by arrow). Myelin of the fibres within the central nervous tissue (CT) is seen negative, $\times 100$.

at all stained by acid hæmatein after pyridine extraction, whereas that of the central nervous tissues was always weakly stained by acid hæmatein after pyridine extraction.² The two

resulted in the growth of all the five lateral buds, while under the lower concentration of ascorbic acid only two or three uppermost lateral buds started growing. The lateral buds on plants under the other two treatments remained completely dormant for a period of five weeks after treatment. This clearly shows that the results obtained are in no way related to the effect of the stabilizer HPO_3 , the buffer used or the resultant decrease in pH value.

It is obvious from the results presented that ascorbic acid is somehow responsible for overriding the inhibitory effect of auxin diffusing from the apical bud. From the quantitative relationship between the concentration of applied ascorbic acid and the removal of apical inhibition it appears that auxin: ascorbic acid ratio largely determines the dormancy or growth of the lateral buds. The lower is this ratio, the more is the offsetting effects of the dominance exercised by the apical bud both in terms of time taken and the number of lateral buds involved. The explanation offered here appears more likely to constitute the *in vivo* mechanism of the promotion of lateral bud development in view of the fact that ascorbic acid is known to be of universal occurrence in plants.¹⁰

The results presented offer strong support to the already postulated concept of ascorbic acid as an important plant regulator.^{4,6,3}

Department of Botany and Plant Pathology,
Punjab Agricultural University,
Hissar, October 29, 1965.

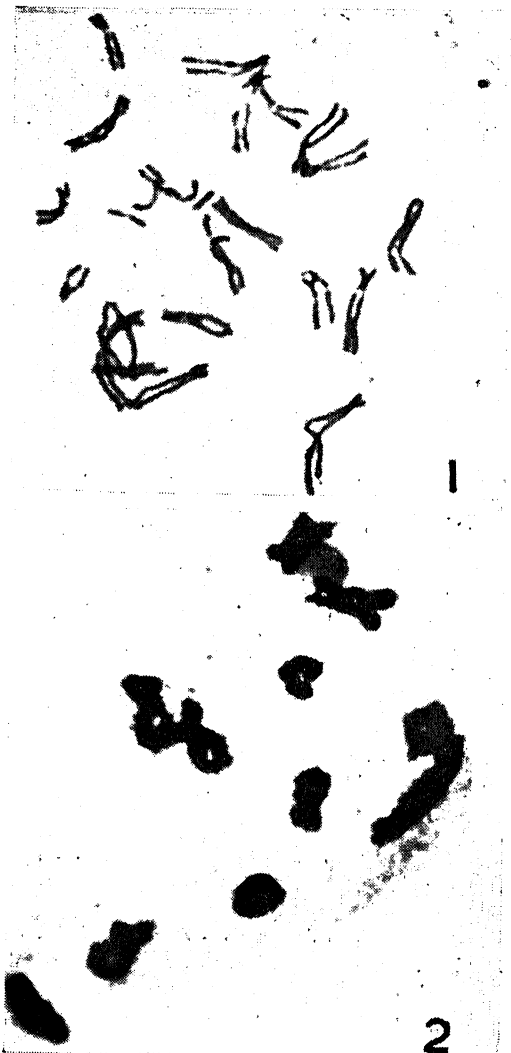
1. Åberg, B., in *Encyclopedia of Plant Physiology*, (Ed. Ruhland, W.), 1958, 6, 479.
2. Brian, P. W., Hemming, H. G. and Radley, M., *Physiol. Plant.*, 1955, 8, 899.
3. Chinoy, J. J., *Indian J. Pl. Physiol.*, 1962, 5, 172.
4. —, Nanda, K. K. and Garg, O. P., *Physiol. Plant.*, 1957, 10, 869.
5. Cooper, W. C., *J. Rio Grande Valley Hort. Soc.*, 1957, 11, 3.
6. Garg, O. P., Chinoy, J. J. and Nanda, K. K., *Phyton*, 1957, 10, 17.
7. Gregory, F. G. and Veale, J. A., *Symp. Soc. exp. Biol.*, 1957, 11, 17.
8. Kato, Y., *Bot. Gaz.*, 1955, 117, 16.
9. —, *Physiol. Plant.*, 1953, 11, 10.
10. Lippert, L. F., Rappaport, F. L. and Timm, H., *Amer. Potato. J.*, 1957, 34, 254.
11. Mapson, L. W., *Ann. Rev. Pl. Physiol.*, 1958, 9, 119.
12. Marth, P. C., Audia, W. V. and Mitchell, J. W., *Bot. Gaz.*, 1956, 118, 106.
13. Thimann, K. V. and Skoog, F., *Proc. Roy. Soc.*, 1934, 114B, 317.
14. — and Wickson, M., *Physiol. Plant.*, 1958, 11, 62.
15. van Overbeek, J., *Bot. Rev.*, 1959, 25, 269.

16. van Overbeek, J., Racusen, D. W., Tagami, M. and Hughes, W. J., *Pl. Physiol.* (Suppl.), 1957, 32, xxxii.
17. Wickson, M. and Thimann, K. V., *Physiol. Plant.*, 1960, 13, 539.

CYTOLOGY OF *CRINUM DEFIXUM*

THE genus *Crinum* is represented by nearly 80-100 species growing in warm and tropical parts of the world.¹ Most of the species are cultivated for ornamental purposes. The white trimerous flowers are borne in an indeterminate umbel subtended by a large bifid bract. The present note deals with the cytology of *Crinum defixum*.

Karyotype analysis was made from root tips prefixed in 8-hydroxyquinoline and stained in



FIGS. 1-2. Fig. 1. Root tip metaphase with $2n=22$, $\times 1125$. Fig. 2. Diakinesis with 11_{II} , $\times 1125$.

Feulgen. For meiotic studies the flowerbuds were removed by dissecting the bulbs and then fixed in Carnoy's fluid. The anthers were squashed in 0.5% propionocarmine.

The somatic complement of the species comprises 22 chromosomes. The centromere in all the 11 pairs occupies a submedian position. The length of the chromosomes ranges from 2.00μ to 15.00μ . At metaphase each chromosome was seen to be made up of two chromatids (Figs. 1, 1a).

Meiosis in the species was regular as the chromosomes showed normal pairing resulting in the formation of 11 bivalents (Fig. 2). These

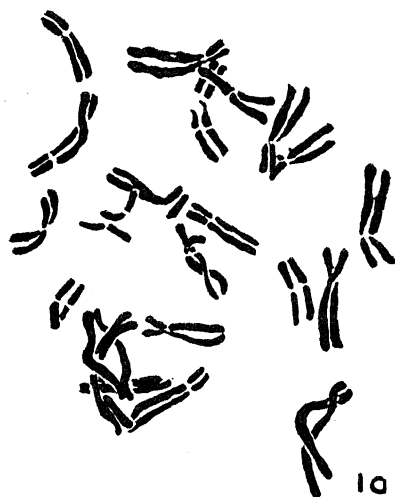


FIG. 1a. Explanatory diagram of Fig. 1, $\times 940$.

were usually of the ring type with both terminal and interstitial chiasmata. Multivalent associations were very rare. Only a few cells showed one quadrivalent. Early separation of the homologues in some of the cells resulted in the presence of 2-4 univalents at prometaphase. Metaphase I and anaphase I were regular in most of the cells. Laggards were observed at anaphase I in 15% of the cells.

Previous reports²⁻⁴ on the chromosome numbers of *Crinum* species suggest that 11 is the basic chromosome number of the genus. The present report of $2n=22$ for *C. defixum* shows that the species is at a diploid level.

Department of Botany, S. L. TANDON.
University of Delhi, MEENAKSHI MATHUR.
Delhi-7, September 26, 1965.

3. Sharma, A. K. and Bhattacharya, N. K., *Genetica*, 1956, **28**, 263.
4. — and Ghosh, C., *Genetica Iberica*, 1954, **16**, 71.

THE INHIBITORY EFFECT OF HEMICHOLINIUM /HC-3/ ON ADAPTATION OF GUINEA PIG TO AEROSOLS OF ACETYLCHOLINE AND HISTAMINE

GUINEA pigs adapted to 1.5-2.0% aerosols of acetylcholine (ACh)¹ well tolerate expositions in 0.5% aerosol of histamine (H), and in 100% survive intravenous injections of ACh or H in doses lethal for the intact animals.² On the other hand, histamine-adapted animals are also tolerant to ACh aerosols and survive LD₁₀₀ of ACh, i.v. These facts indicate that both adaptations, to ACh and H, are presumably dependent on activation of the system: cholinacetylase-acetylcholine-acetylcholine acetylhydrolase (ChA-ACh-AChH). Several data supporting this view have been presented elsewhere.^{2,3}

With the aim of testing if adaptation to ACh and H is dependent on the increased synthesis of ACh, experiments with application of hemicholinium (HC-3)⁴ were carried out. (HC-3 α, α' -dimethylamino-ethanol-4, 4'-biacetophenone) is known as a specific inhibitor of ACh synthesis both *in vivo* and *in vitro*.⁵ It inhibits translocation of choline and prevents its access to the intracellular sites of acetylation.^{6,7}

Male guinea-pigs, weighing 250-90 g, were the test material. HC-3 in doses 0.1 mg/kg body weight was injected intraperitoneally 3 hours before the exposition in aerosol either of ACh or H. The controls did not receive HC-3. Adaptation was carried out according to previously described aerosol technique.^{1,2}

The animals were exposed once a day either to aerosol of ACh or H to the moment of appearance of initial symptoms of the 3rd phase of induced asthmatic-like attack, that is to the moment of bradypnoe.⁸ Guinea-pig which could survive in the expositional chamber for 20 min. without showing symptoms of asthmatic-like attack was regarded as the adapted one.

Initial visible symptoms of respiratory paralysing action of HC-3 appeared after 30 min. from the moment of injection, reached maximal intenseness after about 60 min., and disappeared after 2.0-2.5 hours. All animals of a group exposed in ACh survived two doses of HC-3 injected in 48 hr. interval. A half of the animals did not survive the 3rd dose of HC-3, injected 72 hours after the 2nd one: They died within 45-60 min. Histamine adapted guinea-pigs received only two doses of the inhibitor (cf. Fig. 1).

1. Bailey, L. H., *Manual of Cultivated Plants*, Macmillan Company, New York, 1949.
2. Inariyama, S., *Sci. Rep. Tokyo Bunrika Daig.*, 1937, S.B. No. 52, 95.

It is seen from the data of Fig. 1, control animals within 4 days (*i.e.*, 5 expositions) adapted to 1.5% ACh ($t_0=100$; $t_4=1200$ sec.), and within subsequent 12 days adapted to 1.8% ACh. Hemicholinium, when 1st and 2nd doses are regarded, enhanced ACh-tolerance as tested 3 hrs. after the injection ($t_0=166$; $t_2=880$ sec.). Nevertheless, it markedly inhibited adaptation since $t_1=165$; $t_3=462$; and $t_4=198$ sec. ACh-tolerance practically did not increase during a week after the 3rd injection of HC-3, but subsequently the tolerance rapidly rose up.

HC-3 inhibits also adaptation to 0.5% aerosol of histamine (Fig. 1, curves III and IV).

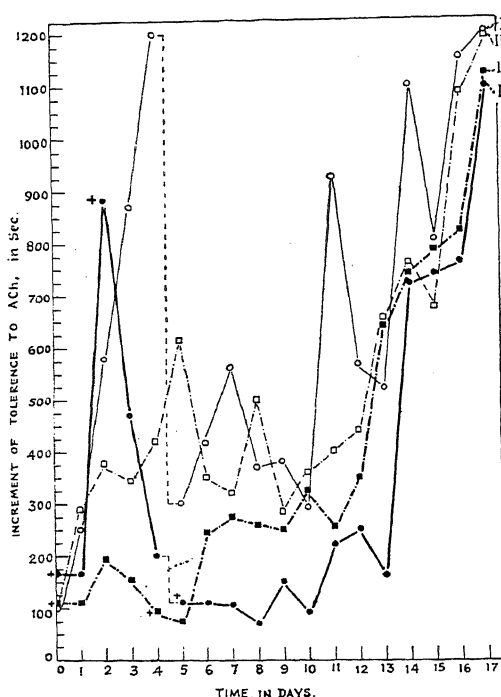


FIG. 1. The effect of HC-3 on adaptation of male guinea-pig to acetylcholine and histamine aerosols. Adaptation to 1.5 and 1.8 per cent ACh: I, without HC-3/the control/and II, with HC-3; vertical dotted lines mark a moment of change of ACh concentration. Adaptation to 0.5 per cent H: III, without HC-3/the control/and IV, with HC-3. * before solid circles or squares means that HC-3/0.1 mg/kg/ was injected 3 hours before the exposition. Aerosols were produced by Dautrebande's generator D-20, modified in this laboratory as a model D-30a. Experiments were carried out in August-September 1964. Acetylcholine chloride was produced by BDH, and histamine dihydrochloride was produced by E. Merck.

It has been found that levels of ACh in hemispheres and cerebellum of the ACh-adapted animals increased up to 2-3 times of

the control values.² The data reported here indicate that continuous and presumably accelerated synthesis of endogenous ACh is important for adaptation to ACh and H. It can be suggested that exogenously applied ACh induces synthesis of AChH; this event in consequence, may be by the feed back mechanism, leads to increased synthesis of ACh. Since adaptation to histamine is coupled with the parallel increment of tolerance to ACh,² the data of Fig. 1 offer additional support for the hypothesis that the system ChA-ACh-AChH plays an essential role in, and is probably a common unspecific part of mechanisms of other types of adaptations to stressors exciting nerve activity, such as histamine⁸ and cold.

Many thanks are due to Dr. J. P. Long, Department of Pharmacology, College of Medicine, State University of Iowa, for a gift of HC-3.

Department of JUSTYNA M. WISNIEWSKA.*
Physiopathology, J. S. KNYPL.**
Medical School, Lodz, Poland.
November 19, 1965.

* On leave from Institute of Experimental Pathology, Polish Academy of Sciences, Warsaw.

** On leave from The University, Lodz, Poland.

1. Wiśniewska, J. M., *Curr. Sci.*, 1964, **33**, 425.
2. —, *Ph.D. Thesis held at the L. Hirszfeld's Institute of Immunology and Experimental Therapy, Wrocław*, 1965.
3. —, and Knypl, J. S., *Curr. Sci.*, 1965, **34**, 451.
4. Schueller, F. W., *J. Pharm. Exp. Therap.*, 1955, **115**, 127.
5. MacIntosh, F. C., Birks, R. I. and Sastry, P. B., *Nature, Lond.*, 1956, **178**, 1181.
6. —, and —, *Neurology, Suppl.* 1, 1958, **8**, 90.
7. —, *Can. J. Biochem. Physiol.*, 1959, **37**, 343.
8. Masliński, Cz. and Wiśniewska, J. M., *Arch. int. Pharmacodyn.*, 1965, **155**, 196.

THE OCCURRENCE OF CYNOMETROXYLON INDICUM CHOWDHURY AND GHOSH FROM THE CUDDALORE SANDSTONE SERIES

Fossil woods showing xylotomical similarities with *Cynometra* of Caesalpiniaceae were discovered for the first time from the Miocene of Assam by Chowdhury and Ghosh¹ and described as *Cynometroxylon indicum*. Navale² has recently reported a new species of *Cynometroxylon*, *C. dakshinense* from the Cuddalore sandstones (Upper Miocene) near Pondicherry, in the South Arcot district.

The present communication deals with a silicification of *Cynometroxylon* from the South Arcot area, exhibiting striking resemblances with *C. indicum* known so far only from the

Tertiaries of Assam. The following is a brief description of the fossil under study.

Wood diffuse-porous; growth rings faint, demarcated by the broader bands of fibres; vessels 170–230 μ in tangential diam., commonly solitary, often in radial multiples of 2 or 3, sparse; perforations simple and oblique; intervessel pits alternate or opposite, apertures lenticular. Parenchyma abundant, aligned in regular concentric seriations (Fig. 1); parenchyma bands essentially apotracheal, 4–10 cells thick, wavy, often branching, relatively thinner

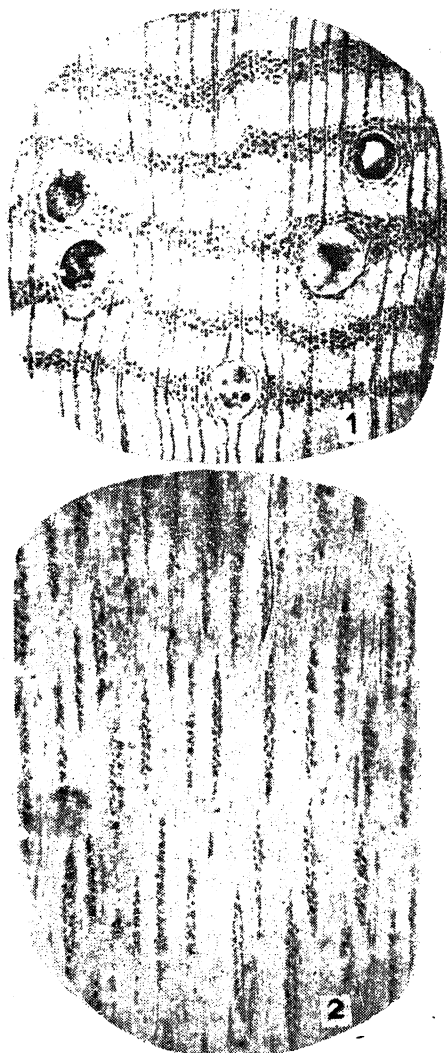
than fibre bands, intercellular spaces prominent, cells with dark contents. Fibre bands 7–15 cells thick, locally as thick as parenchyma; fibres non-septate, libriform. Xylem rays 1–3 seriate, rarely partially 4-seriate; ray tissue heterogeneous; uniseriates either of entirely procumbent cells or with central procumbent and marginal vertical cells; multiseriates heterocellular (Fig. 2).

The South Arcot fossil is strikingly similar to *Cynometroxylon indicum* despite possessing larger vessels and hence placed in the same species.

Cynometra is essentially a tropical taxon with a fairly wide distribution on either side of the equator.³ In the new world it is seen in Mexico and Columbia, and in the old world it extends through Africa to Madagascar and eastward through Indomalayan region to Philippines, Australia and Pacific Islands. In India its species are found in Assam and Bengal in the east and along the western ghats in South.^{3,4} That the same species of *Cynometroxylon* is seen in the Miocene of Assam and South India appears to be of some stratigraphical significance. While *Cynometra* is still represented in the modern flora of Assam by a species, viz., *C. polyandra*, none of its members are found in the S. Arcot district of Madras. They are, however, seen confined more to the west in S. India, i.e., in the Travancore area. Whether the apparent westward shift of this genus in S. India signifies any climatical change in the post-Miocene period of S. Arcot area, is a problem of interest for further study.

We are thankful to Prof. M. R. Suxena for his kind encouragement.

Dept. of Botany, C. G. K. RAMANUJAM.
Osmania University, M. RAGHU RAMA RAO.
Hyderabad, October 9, 1965.



FIGS. 1-2.

1. Chowdhury, K. A. and Ghosh, S. S., *Proc. Nat. Inst. Sci. India*, 1946, 12, 433.
2. Navale, G. K. B., *Palaeobotanist*, 1958, 7, 6.
3. Pearson, R. S. and Brown, H. P., *Commercial Timbers of India*, 1932.
4. Gamble, I. S., *Flora of the Madras Presidency*, 1921.

PHENOLIC ACIDS IN SOME MEMBERS OF PEDALIACEAE

THE present investigation concerns the study of naturally occurring phenolic acids in three plants, *Martynia*, *Pedaliium* and *Sesamum* all of which belong to the family Pedaliaceae of Bentham and Hooker. However, the inclusion of *Martynia* in Pedaliaceae has been questioned on the grounds of comparative morphology, particularly on the characters of placentation and it has been separated from others and given a rank of Martyniaceae.¹

The use of comparative chemistry especially the pattern of phenolic substances in the solution of plant taxonomical problems is brought out in recent years.² An attempt is made here to find out if *Martynia* is in any way different from other members in phenolic acid composition and to know if its separation from Pedaliaceae is justifiable on the grounds of comparative chemistry.

Mature leaves and fruits of *Martynia annua*, L., *Pedaliium murex*, L., and *Sesamum indicum*, L., were collected just before analysis from the plants, the first two of which were growing wild while the third was obtained from the nearby cultivated fields. The extraction of phenolic acids, subsequent paper chromatography and identification of constituents were as per techniques described by Das and Rao.³ The acids identified in the 2.0 g. (fresh weight)

equivalent extracts of leaves and fruits of different plants are shown in Table I.

Taking the phenolic pattern of leaf into consideration *Martynia* appears distinct in possessing *p*-hydroxybenzoic acid while in *Pedaliium* and *Sesamum* this acid is absent. Sinapic acid is another constituent which is present in the leaves of *Martynia* only and is characteristically absent in the other two genera. As regards the fruit *Martynia* is again separate from others in having both *p*-hydroxybenzoic and gentisic acids which are absent in *Pedaliium* and *Sesamum*. Thus an overall picture emerges in which *Martynia* is distinctive and the present work tends to support its separation from Pedaliaceae although other members of the family have also to be examined before a final conclusion is arrived at.

The authors thank Prof. I. M. Rao for encouragement.

Department of Botany,

S.V. University,

Tirupati (A.P.), October 20, 1965.

V. S. R. DAS.

K. N. RAO.

J. V. S. RAO.

1. Hutchinson, J., *The Families of Flowering Plants*, Oxford University Press, 1959, 1.
2. Swain, T., *Chemical Plant Taxonomy*, Academic Press, London, 1963
3. Das, V. S. R. and Rao, J. V. S., *Curr. Sci.*, 1964, 33, 471.
4. Pridham, J. B., *Ann. Rev. Plant Physiol.*, 1965, 16, 13.

TABLE I
Phenolic acids in the leaves and fruits of *Martynia*, *Pedaliium* and *Sesamum*

Acid	Leaf			Fruit		
	<i>Martynia</i>	<i>P. dalium</i>	<i>Sesamum</i>	<i>Martynia</i>	<i>Pedaliium</i>	<i>Sesamum</i>
Caffeic acid	.. +	+	+	+	+	+
Protocatechuic acid	.. +	+	+	—	+	+
<i>p</i> -Hydroxybenzoic acid	.. +	—	—	+	—	—
Gentisic acid	.. +	—	+	+	—	—
<i>p</i> -Coumaric acid	.. +	+	+	—	+	+
Vanillic acid	.. trace	trace	+	trace	—	+
<i>o</i> -Coumaric acid	.. +	+	+	+	+	+
Ferulic acid	.. +	+	+	—	+	+
Sinapic acid	.. +	—	—	—	—	+

Plus (+) indicates presence; Minus (—) indicates absence.

REVIEWS AND NOTICES OF BOOKS

Physical Acoustics. Principles and Methods, Volume II, Part B.—Properties of Polymers and Nonlinear Acoustics. (Academic Press, New York and London), 1965. Pp. xvii + 383. Price \$14.00.

This volume deals with the glasses and polymers—materials which are more closely packed than liquids, but in which atomic movement can still occur.

The first three chapters of this volume are devoted to investigating relaxation phenomena in these materials through the measurement of acoustic attenuation and velocities. The next two chapters, "Non-linear Acoustics" and "Acoustics Streaming," consider the effects of increased energy in sound waves introduced into the transmission medium. Normally, these effects produce the cavitation in liquids, as discussed in Volume I B of this series, the generation of harmonics and the increase in propagation velocities. At large amplitudes, these produce new phenomena, acoustic shock wave and mass motion or acoustic streaming. The last chapter discusses the light diffraction method for measuring nonlinearities of sound waves through analysis of relative intensities of light spectra produced by density change in liquids and piezo-optic effects in solids.

C. V. R.

Advances in the Study of Behavior (Vol. 1). Edited by D. S. Lehrman, R. A. Hinde and E. Shaw. (Academic Press, New York and London), 1965. Pp. x + 320. Price \$9.50.

This new serial publication will review and analyze current problems in behavior with emphasis upon the study of animals. It will contain extensive treatments of specific problems, theoretical discussions, and restatements of classical problems. Distinguished scientists will present retrospective surveys of their own work. Designed primarily for psychologists, zoologists, and psychiatrists, these authoritative volumes will be of great value to research workers and graduate students in experimental and clinical psychology, physiology, endocrinology, psychiatry, neurology, ethnology, and ecology.

The contents of the present volume are: T. C. Schneirla, Aspects of Stimulation and Organization in Approach/Withdrawal Processes Underlying Vertebrate Behavioral

Development; H. F. R. Prechtl, Problems of Behavioral Studies in the Newborn Infant; Richard D. Walk, The Study of Visual Depth and Distance Perception in Animals; Gabriel Horn, Physiological and Psychological Aspects of Selective Perception; Klaus Schmidt-Koenig, Current Problems in Bird Orientation; P. H. Klopfer and J. P. Hailman, Habitat Selection in Birds.

C. V. R.

Current Aspects of Exobiology. Edited by G. Mamikunian and M. H. Briggs. (Pergamon Press, Headington Hill Hall, Oxford), 1965. Pp. xi + 420. Price \$17.00 or £6.

This book presents the early stages in the scientific formulation of Exobiology. The contributed papers indicate the multidisciplinary impetus of the physical and biological sciences that collectively constitutes the working apparatus of Exobiology. The volume begins with an essential and significant chapter on "Organo Cosmo Chemistry" wherein the foundations in the synthesis of the essential constituents of life are both theoretically and experimentally treated. The last chapter on "Trends and Problems of Exobiology" states briefly the considerations underlying the initiation of research and certain problems peculiar to the subject. The volume encompasses several chapters that bridge the two above-mentioned theses. The respective authors of each of the chapters are well-known scientists in their specialized field of work.

The search for "another life" within our solar system is perhaps the most difficult undertaking of our scientific era. The biological exploration of the planet Mars is currently underway for 1969, 1971, and 1973 opposition opportunities. Should any of these missions indicate or dictate the presence of a biota, Exobiology discipline in its own right—the scientific probing for further characterization of the Martian biosphere.

C. V. R.

Fluorine Chemistry (Vol. 4). Edited by J. H. Simons. (Academic Press, New York and London), 1965. Pp. xviii + 786. Price \$28.00.

An extensive survey and discussion of a vast amount of research on the physiological properties of fluoride ion and of substances capable of producing it in aqueous solution are given

in this volume of *Fluorine Chemistry*. These vary from the detrimental effects of excessive fluoride ingestion, through the beneficial effects of optimal amounts, to recognized detrimental effects, i.e., the greater incidence of dental caries accompanying suboptimal fluoride intake. Fluoride metabolism is discussed fully, e.g., the capacity for storage of fluoride by the bones and the rates of excretion of fluoride from the body. Of particular importance is the relation of fluoride ion to the health of teeth and bones; this volume reviews a good deal of careful research on this problem.

C. V. R.

Applied Optics and Optical Engineering (Vol. 1). (A Comprehensive Treatise). Edited by R. Kingslake. (Academic Press, New York and London), 1965. Pp. 423. Price: List Price \$15.00; Subscription Price \$13.00.

This is the first volume of a five-volume treatise which is intended to provide the precise data and information needed by an optical engineer in the design, construction, and testing of new optical devices. It will also assist those who use optical equipment both in selecting a suitable instrument for specifically postulated work and in understanding the details of the operation and use of each instrument. Basic optical theory is covered although the mathematical aspects have been held to a minimum. The principal optical elements such as lenses, mirrors, prisms, gratings, thin films, optical materials, fibres, and filters are discussed in detail. Radiation detectors (visual, photographic, electro-optical, and infra-red) are fully considered, and each type of optical instrument is described by an authority in the particular field.

The contents of the present volume are: Ray P. Teele, Photometry; F. E. Carison and C. N. Clark, Light Sources for Optical Devices; Philip T. Scharf, Filters; Harold S. Stewart and Robert F. Hopfield, Atmospheric Effects; Norbert J. Kreidl and Joseph L. Rood, Optical Materials; Rudolf Kingslake, Basic Geometrical Optics; Adriaan Walther, Diffraction; P. Baumeister, Interference, and Optical Interference Coatings; Robert J. Meltzer, Polarization; R. E. Jacobson, Projection Screens; Ralph D. Geiser, Precision and Accuracy.

C. V. R.

Gardening in Hot Countries. By Arthur Thomas. (Faber and Faber, 24 Russell Square, London), 1965. Pp. 207. Price 30 sh. net.

This is a practical book founded on experience of gardening near the equator in Africa and visits to other regions by the author. In 1923 Dr. Thomas was one of the first people in Britain to be awarded a degree in horticulture but, when he went to the tropics, he found that the methods of temperate gardening needed modification to suit hotter conditions. The indigenous methods of cultivation and growth of wild plants gave ideas more valuable than those in books about temperate gardening.

The life of people and plants in hot countries differs from that of temperate regions and to make the most of gardening near the equator full use should be made of all the beautiful plants which flourish there and less attention should be given to the plants which flourish in the cooler parts of the world. Much can be learnt from European gardens, and from Mediterranean gardens, but gardens near the equator should not copy those of cooler countries.

Much experience of training African assistants who knew little or no English but who were eager to learn has enabled Dr. Thomas to write clearly and simply. This book will therefore be useful to the inhabitants of many countries and, as it is modern in outlook, will be invaluable to those who go from temperate countries to live in the tropics.

C. V. R.

Rapid Mixing and Sampling Techniques in Chemistry. Edited by Britton Chance, Ruth H. Eisenhardt, Quentin H. Gibson, and K. Lonberg-Holm. (Academic Press, New York and London), 1964. Pp. xii + 400. Price \$9.00.

This volume covers the Proceedings of the First International Colloquium on Rapid Mixing and Sampling Techniques Applicable to the Study of Biochemical Reactions held in Philadelphia on July 23 and 24, 1964. The subject-matter is dealt with in two sections, Rapid Flow Methods and Rapid Stopping Sampling Techniques. Section I comprises chapters whose titles and the number of contributions in each are as follows: I. Rapid Mixing and Fluid Flow—Five; II. Injection into a Fixed Volume—Four; III. Stopped Flow Methods—Three; IV. Continuous Flow Methods—Four, and V. Flow with Photolysis and Temperature Jump—Four.

Section II comprises three chapters whose titles and the number of contributions in each are as follows: I. Liquid-Liquid Quenching

Five; II. Tissue Freeze Quenching—Four and III. Rapid Sampling Techniques—Nine. In addition to the above there are seven contributions added to the volume at the end of it under the heading "Appendices". C. V. R.

British Medical Bulletin: Recent Research in Molecular Biology (Vol. 21), Number 3. (Medical Department, The British Council, 65, Davies Street, London, W. 1), September 1965. Pp. 183 to 278. Price £1. 10 sh. 0 d.

The titles of the articles contained in this book are as follows: Introduction, by F. H. C. Crick; Physical Chemistry of Transforming DNA, by R. Rownd; Biochemistry of DNA and RNA Replication, by R. M. S. Smellie; Structure and Replication of the Bacterial Chromosome, by R. H. Pritchard; Genetic Transfer during Bacterial Conjugation, by Julian D. Gross; Intracellular Modification of Nucleic Acids, by K. A. Stacey; Mechanism of Protein Biosynthesis, by H. R. V. Arnstein; Antibiotics, Proteins and Nucleic Acids, by J. F. Collins; The Genetic Code, by A. O. W. Stretton; Amino-Acid-Transfer RNA: Structure and Function, by G. L. Brown and Sheila Lee; Theories of Gene Regulation, by S. Brenner; Interallelic Complementation *in vivo* and *in vitro*, by Obaid Siddiqi; Infectious Drug Resistance, by Naomi Datta; Penicillinase Plasmids in *Staphylococcus aureus*, by M. H. Richmond; Molecular Basis of Contractility in Muscle, by Jean Hanson and J. Lowy. C. V. R.

Advances in Control Systems (Vol. 1). Edited by C. T. Leondes. (Academic Press, New York and London), 1964. Pp. x + 365. Price \$13.00.

The primary purpose of this series is to bring together current information from leading researchers in the ever-broadening field of automatic control. The large number of practising engineers, applied mathematicians, and other scientists being drawn into this field, together with the increase in student enrolment in systems engineering, insures a steady flow of new results in the future. Those directly active in developing control theory, as well as those who use techniques of automatic control as an effective tool, will find this series invaluable as a comprehensive and readily accessible compilation of information. The teacher will find it a timely and convenient source to which to refer his students.

The subject in this volume is dealt with in six chapters whose titles and their respective

authors are as follows: On Optimal and Sub-optimal Policies in Control Systems, by Masanao Aoki; The Pontryagin Maximum Principle and Some of Its Applications, by James S. Meditch; Control of Distributed Parameter Systems, by P. K. C. Wang; Optimal Control for Systems Described by Difference Equations, by Hubert Halkin; An Optimal Control Problem with State Vector Measurement Errors, by Peter R. Schultz; On Line Computer Control Techniques and Their Application to Re-entry Aerospace Vehicle Control, by Francis H. Kishi. C. V. R.

Nonlinear Problems of Engineering. Edited by W. F. Ames. (Academic Press, New York and London), 1964. Pp. xiv + 252. Price \$10.75.

The contributors to this volume use analytic, approximate, and numerical mathematical methods in examining the nonlinear problems of engineering. The unifying theme is the construction of nonlinear mathematical models. The material extends over a wide range: from a particular mathematical study of analytic function iteration, through networks of inextensible cords, to a numerical method.

In addition to suggesting lines for future study, this book is unique in its attempt to familiarize a spectrum of mathematicians, scientists, and engineers with the current state of research. C. V. R.

Biochemistry and Physiology of Protozoa (Vol. 3). Edited by S. H. Hutner. (Academic Press, New York and London), 1964. Pp. xiv + 616. Price \$18.50.

This volume reflects the growing use of protozoa as research tools. The topics covered include the sensory, molecular and macromolecular basis of locomotion; the uses of flagellates and ciliates in biochemical and genetical research; and metabolic mechanisms in anti-trypanosomal and antimalarial chemotherapy.

The book contains the following fourteen contributions by the authors whose names are shown against each: Introduction, by S. H. Hutner; Environmentally Induced Growth Oscillations in Protozoa, by Otto H. Scherbaum and John B. Loeffler; Protoplasmic Movements and Locomotion of Protozoa, by Theodore L. Jahn and Eugene C. Bovee; The Locomotor Apparatus of Ciliates and Flagellates: Relations between Structure and Function, by Dorothy R. Pitelka and Frank M. Child; Nutrition and Metabolism of Ciliates, by G. G. Holz, Jr., Physiological Genetics of the Ciliates, by R. F. Kimball; Phototaxis in Protozoa, by Per Halldal;

Studies of Cell Heredity with *Chlamydomonas*, by Ruth Sager; The Plastid Pigments of Flagellates, by T. W. Goodwin; Biochemistry of Acrasiales, by Barbara E. Wright; The Physiology of Trichomonads, by Mary S. Shorb; Nutrition and Physiology of the Trypanosomatidae, by Helene N. Guttman and Franklin G. Wallace; The Chemotherapy of Trypanosomiasis, by L. G. Goodwin and the Chemotherapy of Malaria, by I. M. Rollo.

C. V. R.

Dynamical Theory of Groups and Fields. By Bryce S. DeWitt. (Documents on Modern Physics), (Gordon and Breach, Science Publishers, 150, Fifth Avenue, New York 11, N.Y.), 1965. Pp. 250. Price: Paper \$2.95; Cloth \$5.95.

This book is based on a series of lectures which the author gave at the Les Houches Summer School in 1963. It was first published as part of a larger volume, *Relativity, Groups and Topology* (Gordon and Breach, 1964) which contains all of the lectures given at Les Houches that summer. A few trivial mistakes in the original have been corrected in the present volume, and a chapter has been added at the end which sketches in barest outline a theory of the higher order radiative corrections for non-Abelian gauge fields, a problem that was left dangling in 1963.

C. V. R.

Advances in Applied Microbiology (Vol. 6). Edited by Wayne W. Umbreit. (Academic Press, New York and London), 1964. Pp. ix + 259. Price \$10.00.

Volume 6 of this well-known series contains the following eight contributions by the authors whose names are shown against each: (1) Global Impacts of Applied Microbiology: An Appraisal, by Carl-Goran Heden and Mortimer P. Starr; (2) Microbial Processes for Preparation of Radioactive Compounds, by D. Perlman, Aris P. Bayan and Nancy A. Giuffre; (3) Secondary Factors in Fermentation Processes, by P. Margalith; (4) Non-medical Uses of Antibiotics, by Herbert S. Goldberg; (5) Microbial Aspects of Water Pollution Control, by K. Wuhrmann; (6) Microbial Formation and Degradation of Minerals, by Melvin P. Silverman and Henry L. Ehrlich; (7) Enzymes and Their Applications, by Irwin W. Sizer; (8) A Discussion of the Training of Applied Microbiologists, by B. W. Koff and Wayne W. Umbreit.

C. V. R.

Continuous Cultivation of Micro-organisms.

Edited by I. Malek K. Beran and J. Hospodka. (Academic Press, New York and London), 1964. Pp. 391. Price \$14.50.

This volume includes the full proceedings of sessions of the Second International Symposium on continuous cultivation of micro-organisms, which took place in Prague, from June 18th to 23rd June 1962. In all, fifty-two members participated in the symposium and the number of contributions made by them was 38.

The First International Symposium, held in Prague in June 1958, requested the Microbiological Institute, Czechoslovak Academy of Sciences, to help in co-ordinating scientific research concerned with the development of this method, which is so important at a time when microbiology has become an important field of biological and biochemical fundamental research, and when it has broadened its applications in industrial production. The organisation of the second symposium and the publication of its materials in this volume serve as a means of fulfilling the task referred to above.

C. V. R.

Books Received

Photometry (3rd Edition). By J. W. T. Walsh. (Dover Publications, New York), 1965. Pp. 544. Price \$3.00.

Electrodynamics. By L. Page and N. I. Adams. (Dover Publications, New York), 1965. Pp. 505. Price \$2.50.

Elements of Chemistry. By A. Lavoisier. (Dover Publication, New York), 1965. Pp. xxxi + 511. Price \$3.00.

Transmission Line Theory. By R. W. P. King. (Dover Publications, New York), 1965. Pp. xii + 513. Price \$2.75.

Theory of Elasticity and Plasticity. By H. M. Westergaard. (Dover Publications, New York-14, N.Y.), 1965. Pp. xii + 176. Price \$1.75.

Behavior of Metals Under Impulsive Loads. By J. S. Rinehart and Pearson. (Dover Publications, New York-14, N.Y.), 1965. Pp. 256. Price \$2.00.

Sensory Restriction Effects on Behavior. By D. P. Schultz. (Academic Press, New York), 1965. Pp. viii + 216. Price \$7.50.

Stories from Science (Book 3). By A. Sutcliffe and A. P. D. Sutcliffe. (Cambridge University Press, London N.W. 1), 1965. Pp. 128. Price 15 sh.; (Book 4), Pp. 120. Price 15 sh.

THE NEW PHYSIOLOGY OF VISION

Chapter XXXVIII. The Adaptation of Vision to Dim Light

SIR C. V. RAMAN

THE enormous disparity between the illumination available from natural sources by day and by night justifies the terms day-vision and night-vision being used to describe the functioning of our visual organs respectively in these two widely different sets of circumstances. From the investigations set out in the two preceding chapters, it emerged that there is no real difference between day-vision and night-vision except that in the latter case, the red, yellow and blue sectors of the spectrum are not perceived and that only the green, in other words, the part of the spectrum appearing in the wavelength range between $500\text{ m}\mu$ and $560\text{ m}\mu$ is effective and enables us to perceive illuminated objects. With the aid of three colour filters, viz., those which transmit only the red, green and blue sectors respectively—excluding in each case the rest of the spectrum—these features of night-vision can be readily demonstrated. The red and the blue filters appear opaque and do not allow of feebly illuminated objects being readily perceived through them. On the other hand, the green filter appears transparent and allows the details of the objects under view to be seen and recognised.

The change-over from day-vision to night-vision can be followed by an observer who views a long narrow slit through which the light of the sky finds entry into a darkened room, while holding a replica diffraction-grating before his eye. The insertion of each colour-filter in turn before the diffraction-grating allows the particular part of the spectrum which it transmits to be seen while the rest is excluded. If such observations are made during the twilight period with the red or the blue filters, a progressive contraction followed by a total extinction is noticeable of the parts of the spectrum which they respectively transmit. But in the case of the green filter, the part of the spectrum transmitted by it remains visible and continues to be seen even, after the cessation of twilight and when the light under observation is that of the night-sky.

The differences between day-vision and night-vision can also be demonstrated by observations in a dark room, entry of day-light into which is permitted under control by an iris-diaphragm covering a circular sky-light. The opening-of

the iris can be set as desired, thereby enabling the illumination of objects within the room to be varied over a great range. Holding a colour-filter before his eye, the observer can view the objects in the room at any desired level of illumination. Particularly suitable for such observations is an ophthalmic chart, viz., a white card carrying several rows of printed letters of different sizes. When the opening of the iris is large enough, the chart can be seen and the letters on it can be read through each of the three colour-filters in turn, viz., red, green and blue. But when the iris is closed down sufficiently, the chart ceases to be visible through the red and the blue filters, whereas it can be seen and the printed letters on it can be read using the green filter.

During the period of twilight which intervenes between day and night, human vision adjusts itself automatically to the greatly reduced level of illumination which results from the setting of the sun. If, however, the transition from light to darkness is sudden, as for example, when an observer moves into a dimly-lighted room from a brightly-lighted exterior, he is at first unable to perceive the faintly illuminated objects inside the room. It is found that an appreciable interval of time is needed for his vision to adjust itself to the lower level of illumination. This change or adjustment of vision to an altered level of illumination is usually referred to as "adaptation". It has been the topic of numerous studies and discussions. We shall in what follows consider the subject in the light of our findings regarding the nature of the differences between day-vision and night-vision. We shall also report some new observational results which enable us to arrive at definite conclusions regarding the nature and origin of the phenomenon.

The Period of Adaptation.—The basic feature of adaptation is that it is progressive with time. It begins when the observer whose vision has fully adjusted itself to a particular level of illumination of the objects around him transfers himself to a different environment which, we shall assume, represents a lower level of brightness. The adaptation ends when his vision attains a steady state corresponding to such lower level. The questions which arise and call for our answer are the following. What

is the nature of the change which occurs in the visual apparatus and what determines the time required for it?

When considering these questions, we may usefully here recall some well-known facts of experience. The time required for vision to adapt itself to a new set of circumstances is determined both by its initial and final states. It can be stated in a general way that the more widely different they are, the greater is the time needed. If, for example, the first level is in the range of day-light vision and the second in the range of night-vision, the time needed would be quite considerable. If, on the other hand, both of the levels of brightness are in the day-light range, the adaptation would take place much more quickly.

It may also be remarked that the role played by adaptation in the perception of light is specially conspicuous in the case of faintly illuminated objects but is much less evident in the case of those which are brilliantly lighted. For example, an observer entering a dimly-lit room may find some difficulty in recognising objects located in the darker corners. But any metallic objects or other polished surfaces in the same area which reflect light falling on them directly towards his eyes are immediately perceived.

To obtain a fuller insight into the nature and origin of the phenomena of adaptation, we may use the same technique as that described earlier. The observations are conveniently made in a dark room of which the illumination admits of being controlled by opening or closing a iris-diaphragm covering a circular sky-light. The use of an ophthalmic chart as the test-object is also highly advantageous. The observer should place himself at such a distance from the chart that he can read all the letters on it without difficulty if the illumination is adequate. To begin with, the observer's vision may be adapted to bright day-light, and the iris-opening of the sky-light reduced to its minimum, so that the illumination of the chart is extremely feeble. The process of accommodation is then naturally slow. The observations may then be repeated in successive stages with the iris more widely open and the shortening of the period of accommodation which results thereby is made evident.

Studies of adaptation in this manner reveal that the progressive increase of the observed brightness of the test-chart during the period of adaptation is accompanied by a simultaneous increase in the visibility of the printed letters

on the test-chart. Another remarkable phenomenon is also noticed in these studies. If at any stage during the progress of adaptation, the observer moves forward and comes close to the chart, he notices a great brightening up of its entire area, while simultaneously all the letters on it spring into view and can be read with ease. A similar spectacular increase of visual brightness is exhibited by any feebly illuminated diffusing screen when an observer approaches close to it when his vision is not fully adapted to the low level of brightness.

Another significant observation of interest may also be noted here. Two similar diffusing screens of white plastic material are placed in the path of the light diverging from the sky-light but at different distances from it. For example, one may be twice as far from the light-source as the other. The ratio of their illuminations is then one to four, but their visually observed brightness differs to a far greater extent. At the beginning of the period of adaptation, the more distant screen is scarcely visible, while the nearer screen is a conspicuous object. Only at a later stage does the ratio of their visually observed brightness become at all comparable with the ratio of the illumination of two screens.

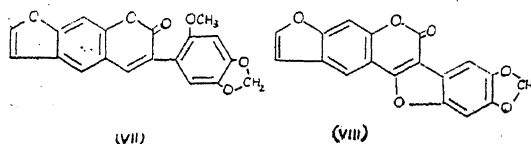
The Nature of Adaptation.—The observations set forth above leave little room for doubt as to the exact nature of the changes in the visual apparatus that manifest themselves in the phenomena of adaptation. What is actually observed is that when an observer remains for a sufficient period in a brightly lighted environment, there is a large reduction in his power to perceive feeble light, but that on the other hand the ability to perceive bright light remains more or less unimpaired. The only explanation of this phenomenon that could be suggested and that could be reconciled with the facts of observation set forth above is that the individual receptors of light in the retina exhibit an effect in the nature of fatigue as the result of a continued functioning in bright light for a long period of time. Such fatigue results in their inability to receive and transmit very weak impulses to the cerebral centres, while on the other hand their ability to receive and transmit more powerful impulses is not seriously impaired. Prolonged rest in darkness may be expected to abolish this fatigue and enable feeble illumination to be perceived to the same extent and in the same manner as bright light.

CHEMICAL COMPONENTS OF YAM BEANS: THEIR EVOLUTION AND INTERRELATIONSHIP

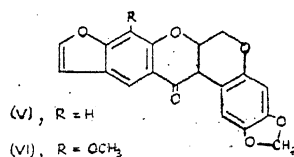
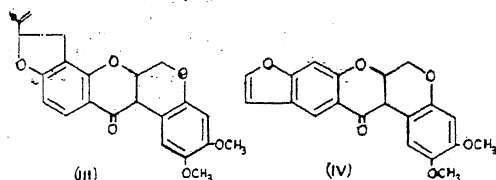
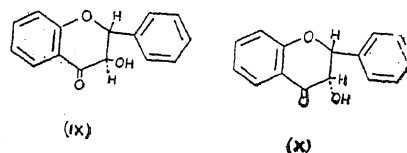
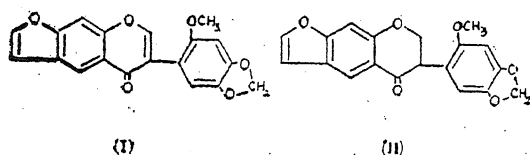
M. KRISHNAMURTI AND T. R. SESHADRI

Department of Chemistry, University of Delhi, Delhi-7

PACHYRRHIZUS EROSUS (Sankh alu) is cultivated throughout India, but not known in a wild state. The tuberous root resembles a turnip in taste and consistence. It is eaten both raw and boiled. The seeds are toxic and the toxicity is comparable to that of the rotenone bearing roots of *Derris* and *Lonchocarpus*. The earliest study of the seeds was made by Nag *et al.*,¹ who considered the toxic principle to be a saponin. A more detailed examination was carried out by Norton and Hansberry² who isolated six crystalline compounds from them. One of these was identified as rotenone (III) and the second designated as erosone (IV) was shown to be closely related to elliptone and was its linear isomer; in it the furan ring is linearly fused whereas in elliptone it is angular. The structures of three more were determined by Schmid and his colleagues. These were pachyrrhizin³ (VII), erosin⁴ (VIII) and pachyrrhizon⁵ (VI). The sixth compound was identified as dehydroneotenone (I) by Crombie and Whiting⁶ who also established the presence of two more, dolineone (V) and neotenone (II). Thus the seeds of *Pachyrrhizus erosus* contain eight closely related compounds; an isoflavone (I), an isoflavanone (II), four rotenoids (III, IV, V and VI) and two furano-3-phenyl coumarins (VII and VIII). The isolation of these from the same plant is of considerable biogenetic interest.



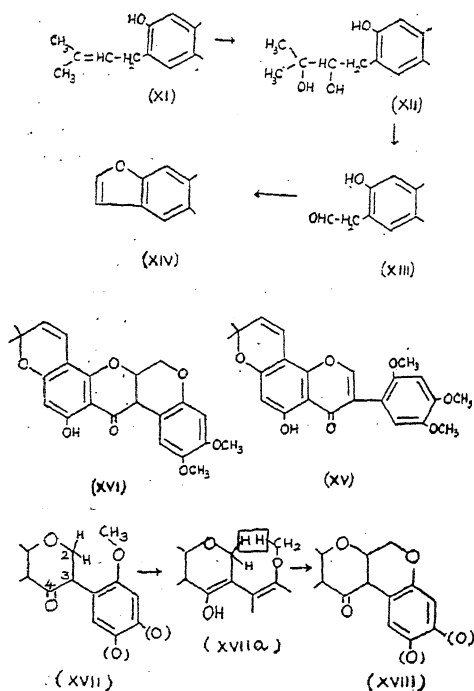
It is clear that the three types are closely related with the same carbon skeleton and very similar substitution patterns. There is no doubt that they have common origin and somewhat common evolution and have diversified in the end stages. The following comments may be made about the interrelationships and possible stages of evolution. The simplest of these compounds are the isoflavone (I) and isoflavanone (II). These are hydrogenation and dehydrogenation products. The evolution of isoflavones has already been discussed.⁷ There seems to be little doubt that they arise from chalcones which can easily isomerise into flavanones. It has been recently mentioned that flavanones, and not the 3-hydroxy flavanones, give rise to isoflavones.⁸ This point may require reconsideration. The more stable *trans*-3-hydroxyflavanones (IX) may not undergo this change. However it is quite possible that the less stable *cis*-3-hydroxyflavanones (X) may easily eliminate water and in the process undergo conversion into isoflavones.



The evolution of furan ring has also been discussed and established elsewhere.⁹ The origin seems to be a dimethylallyl unit which undergoes oxidative splitting off three carbon atoms with subsequent ring closure (see XI to XIV). The furan ring is present in all the eight compounds of yam beans. The above scheme of biogenesis is substantiated by the presence of a C₅ unit intact in one of the compounds, *viz.*, rotenone.

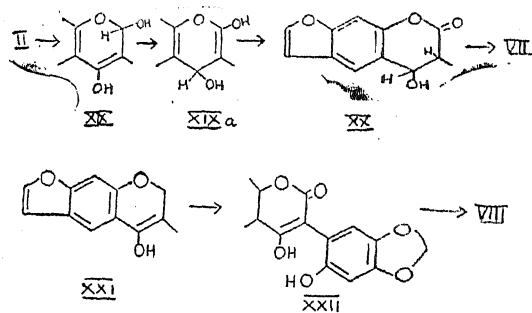
The occurrence of a 2'-OCH₃ substituted isoflavone (dehydroneotenone, I) and isoflavanone (neotenone, II) along with dolineone is a

second example of the co-occurrence of an isoflavonoid with a related rotenoid. The first was toxicarol isoflavone (XV) which is found along with toxicarol (XVI) in *Derris malaccensis*.¹⁰ These examples would suggest that the formation of the pyran ring may consist of a simple transformation involving possibly a free radical oxidation between the $-\text{CH}_2$ group in the 2-position and the $-\text{OCH}_3$ at the 2'-position. An analogy for this idea is the formation of methylenedioxy compounds from guaiacol units by this process of oxidation.¹¹ In the present case the 2-position can become more reactive by assuming the enol form (see XVII a).

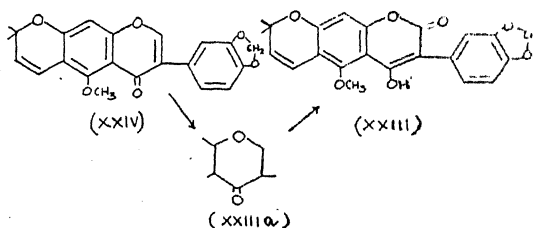


The close structural relationship between the two coumarin derivatives, pachyrrhizin and erosin, is obvious. They should therefore have very closely similar paths of biogenesis also originating from isoflavones and isoflavanones. It appears quite possible that oxidation in the 2-position of the isoflavanone (II) (enol form) without involving ring closure may lead to a 2'-hydroxyisoflavanone (XIX) which undergoes allylic isomerisation to the corresponding coumarin derivative (XX) followed by dehydration yielding the simpler 3-phenyl coumarin (VII). Somewhat similar changes are involved in the formation of (VIII) but in this case the presence of a free 2'-hydroxyl should make the difference. The steps would be the formation of

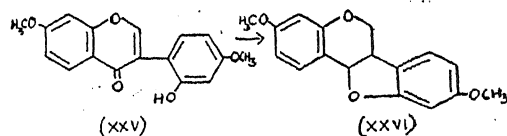
the enol (XXI) hydroxylactone (XXII) and ring closure.



In this connection could be recounted the presence of rotenoids and non-rotenoids in related *Derris* species. The non-rotenoids¹² in these cases are the 3-phenyl-4-hydroxy coumarins (e.g., XXIII) having no substitution in the 2'-position. This absence would explain their ready formation from isoflavones (XXIV) which accompanies them and also the lack of further change.¹³

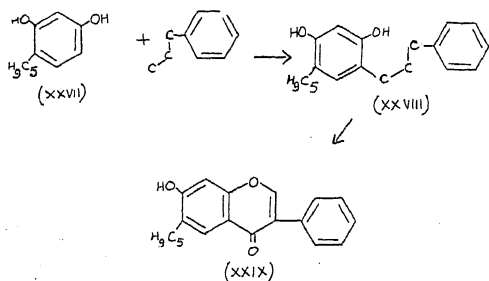


The formation of pterocarpin type which are common in the heartwood of pterocarpus species is obviously due to a slightly different method of evolution where 2'-hydroxy isoflavanone undergoes reductive ring closure. This has been confirmed by laboratory experiments and a number of compounds of this type have been made¹⁴ by reducing the appropriate isoflavones with sodium borohydride.



A special feature with seven out of the eight compounds of *Pachyrrhizus erosus* is that they all have a linearly fused furan ring; the only exception is rotenone. It is known that the entry of a dimethylallyl group takes place preferentially in the 8-position in flavonoids and a corresponding position in the related resacetophenone derivatives. The formation of

the linear compounds would involve entry of this unit in the position corresponding to 6. This would be possible if in these cases a C₅ unit got attached to the original C₆ component of the flavonoid before it was linked with the C₉ component.



1. Nag, N. C., Banerjee, H. N. and Pain, A. K., *Trans. Bose Research Inst.*, 1935-36, 11, 83.
2. Norton, L. B. and Hansberry, R., *J. Amer. Chem. Soc.*, 1945, 67, 1609.
3. Simonitsch, E., Frei, H. and Schmid, H., *Monatsh.*, 1957, 88, 541; Rajagopalan, P. and Kosak, T. I., *Tetrahedron Letters*, 1959, 21, 5.

4. Eisenbeiss, J. and Schmid, H., *Helv. Chim. Acta*, 1959, 42, 61.
- Chatterjea, J. N. and Prasad, N., *Bir.*, 1964, 97, 1252.
5. Bickel, H. and Schmid, H., *Helv. Chim. Acta*, 1953, 36, 664.
6. Crombie, L. and Whiting, D. A., *J. Chem. Soc.*, 1963, p. 1569.
7. Chibber, S. S. and Seshadri, T. R., *Curr. Sci.*, 1965, 34, 238.
8. Barz, W., Patschke, L. and Grisebach, I., *Chem. Comm.*, 1965, p. 400.
9. Aneja, R., Mukerjee, S. K. and Seshadri, T. R., *Tetrahedron*, 1968, 4, 256.
10. Harper, S. H., *J. Chem. Soc.*, 1939, p. 812; 1940, pp. 309 and 1178.
11. Barton, D. H. R., Kirby, G. W., Taylor, J. B. and Thomas, G. M., *Ibid.*, 1963, p. 4545.
12. Ollis, W. D., *Abstracts of International Symposium on Natural Products, Japan*, 1964, p. 391 and private communication.
13. Johnson, A. P., Pelter, A. and Barber, M., *Tetrahedron Letters*, 1964, p. 1267.
- Pelter, A. and Stainton, P., *Ibid.*, 1964, p. 1309.
- and Johnson, A. P., *Ibid.*, 1964, p. 2817.
14. Aghoramurti, K., Kukla, A. S. and Seshadri, T. R., *Curr. Sci.*, 1961, 30, 218; Kalra, V. K., Kukla, A. S. and Seshadri, T. R., Unpublished work.

ANALYSIS OF PHENOL, HYDROQUINONE, QUINONE AND MALEIC ANHYDRIDE IN A MIXTURE

M. C. BADARINARAYANA, S. H. IBRAHIM AND N. R. KULLOOR

Department of Chemical Engineering, Indian Institute of Science, Bangalore-12

THE study of catalytic vapour phase oxidation of benzene involves the problem of estimating phenol, hydroquinone, quinone and maleic anhydride in a mixture of all these along with unreacted benzene. Though there are a number of methods for the estimation of the individual compounds, there has been no report of any detailed work pertaining to the interferences by the other compounds present while estimating each of these in a mixture. Denton *et al.*¹ as well as Marisic² in their studies on the oxidation of aromatic compounds have employed a procedure involving separation of the compounds and subsequent analysis of them individually. However, it is preferable to estimate each constituent in a mixture as such than employ a quantitative separation followed by individual estimation. With this in view, synthetic mixtures containing known amounts of phenol, hydroquinone, quinone and maleic anhydride were prepared and a procedure for estimating the compounds was evolved after extensive testing.

A large number of methods of estimating phenol are based on the bromination of phenol followed by determination of the excess reagent. Phenol being acidic can also be determined by alkalimetric titration. However, in presence of carboxylic acids such estimations are not possible. Also the highly sensitive colorimetric method cannot be employed here since the presence of even small amounts of quinone and hydroquinone will modify the characteristic phenol colouration considerably.³ Hence bromination method was adopted here for the estimation of phenol in these synthetic mixtures. The bromination was carried out using bromate-bromide reagent.⁴

Reagents:

- (i) 0.1 N sodium thiosulphate solution prepared by dissolving 24.8 g. of Na₂S₂O₃ · 5H₂O in one litre of water.
- (ii) Brominating solution consisting of 3.5 g. of potassium bromate and 55 g. of potassium bromide in one litre of solution.

- (iii) Concentrated hydrochloric acid (sp. gr. 1.2).
 (iv) 20% potassium iodide solution.
 (v) 1% starch solution.

Some of the results of such determinations are indicated in Table I.

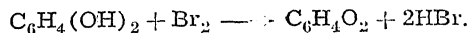
TABLE I

Results of phenol estimation in synthetic mixture

Amount in grams taken				Phenol determined	
Phenol	Hydro-quinone	Maleic anhydride	Quinone	Without correction	With correction
0.7528	..	0.1028	..	0.7968	..
0.7968	..	0.1028	..	0.8041	..
0.7528	..	..	0.0146	0.7528	..
0.7528	0.07685	..	..	1.0349	0.7598
0.7528	0.07685	..	..	1.0330	0.7579
0.01356	0.01618	0.01082	0.003892	0.01685	0.0145
0.3945	0.0721	0.02204	..	0.4446	0.3922

It is seen from Table I that the bromometric method of estimating phenol is quite satisfactory even in the presence of maleic anhydride. Bromination is also a method of estimating the unsaturation in maleic anhydride.⁵ In spite of this, maleic anhydride is found to have no significant effect on phenol estimation, probably due to the differences in the conditions employed for bromination in the two cases. For the bromination of maleic anhydride, a catalyst like mercuric sulphate as well as longer period of reaction is necessary. In one of the estimations in presence of maleic anhydride a high deviation of 5.52% (estimated value of 0.7968 g for 0.7528 g) was obtained because of carrying out the bromination for more than half-an-hour instead of the fifteen minutes normally employed. Otherwise, when normal procedure is employed phenol estimation can be carried out in presence of maleic anhydride within one per cent deviation. The table also indicates that quinone does not interfere in the estimation. The results further indicate that the presence of hydroquinone very much affects the phenol estimation. This is contrary to the observation of Kolthoff et al.⁶ who indicate that in the bromometric determination of phenols, compounds with two hydroxyl groups in the ortho or para position do not react with bromine at room temperature. Experimentally it has been found that the volume of brominating solution consumed while brominating a sample of the synthetic mixture is in excess of that required for bromination of phenol alone in the mixture. This excess volume is found to correspond to computed

volume assuming the following reaction between bromine and hydroquinone.



Thus, on computing estimated value of phenol after taking into account the correction for bromine consumption due to hydroquinone, satisfactory values are obtained as shown in Table I. Hence this method can be employed for the estimation of phenol in a mixture of phenol, hydroquinone, quinone and maleic anhydride provided an independent estimation of hydroquinone and thus the bromine consumption due to hydroquinone can be obtained. Hydroquinone can be estimated by quantitatively oxidising it to quinone and determining the excess of reagent. The oxidation can be brought about by iodine,⁷ dichromate⁸ or ceric sulphate.⁹ It was found that iodometric estimation of hydroquinone could be carried out within 2% deviation in presence of phenol, maleic anhydride and quinone.

For the estimation of quinone, use was made of its reaction with an acidified solution of potassium iodide¹⁰ and was found satisfactory.

Alkalimetric titration was found fairly accurate in estimating maleic anhydride in the synthetic mixture, though there have been reports of difficulty in estimating anhydride in presence of quinone.¹¹ The results which are accurate to within 2% are further improved if the solution of the mixture is boiled before carrying out the analysis for anhydride. Similar observations have been made by Bhattacharya and Venkataraman.¹²

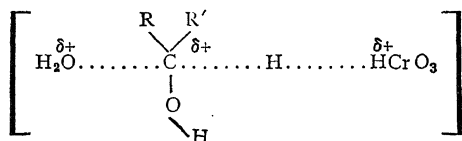
1. Denton, V. I., Doherty, H. G. and Kriebel, R. H., *Ind. Eng. Chem.* 1950, **42**, 777.
2. Marisic, M. M., *J. Am. Chem. Soc.*, 1940, **62**, 2312.
3. Ju Chin Chu, Ai, H. C. and Othmer, D. E., *Ind. Eng. Chem.*, 1953, **45**, 1267.
4. Day, A. R. and Taggart, W. T., *Ibid.*, 1928, **20**, 545.
5. Lucas, H. J. and Pressman, D., *Ind. Eng. Chem., Anal. Ed.*, 1938, **10**, 140.
6. Kolthoff, I. M. and Belcher, R., *Volumetric Analysis*, 1957, **3**, 536 (Interscience).
7. — and Lee, T. S., *Ind. Eng. Chem., Anal. Ed.*, 1946, **18**, 452.
8. Bhaskara Rao, K., *Z. anal. Chem.*, 1963, **185** (4), 286.
9. Furman, N. H. and Wallace, J. H., *J. Am. Chem. Soc.*, 1930, **52**, 1443.
10. Richter Victor Von, *The Chemistry of Carbon Compounds* (Elsevier), 1946, **3**, 186.
11. Shreve, R. N. and Welbron, R. W., *Ind. Eng. Chem.*, 1943, **35**, 279.
12. Bhattacharya, S. K. and Venkataraman, N., *J. Appl. Chem.*, 1958, **8**, 728.

LETTERS TO THE EDITOR

THE APPLICATION OF THE BUNNETT CRITERION TO THE MECHANISM FOR THE CHROMIC ACID OXIDATION OF SECONDARY ALCOHOLS

INVESTIGATING the change in rate of CrO_3 oxidation of isopropyl alcohol, with the variation of the acidity of the medium, Roček and Krupicka¹ have shown that a good linearity exists between $\log k$ and the Hammett acidity function H_0 in strong H_2SO_4 . This has been interpreted by them as indicating the non-participation of a water molecule in the transition state. It has however been argued² that an activated complex composed of a molecule of alcohol, HCrO_4^- ion, and a molecule of water would virtually be equivalent to one composed of a molecule of alcohol, one of undissociated chromic acid and a proton and this would follow H_0 . In view of the fact that the applicability of the Zucker-Hammett hypothesis to carbonium ion processes has been repeatedly questioned^{3,4} (and Roček and Krupicka's argument was based on this hypothesis) Kwart⁵ has re-examined the data by applying to it the Bunnett treatment⁶ whereby the number and role of water molecules in the transition state may be estimated by evaluating the parameter ω , the slope of the plots of $\log k + H_0$ against $\log a_{\text{H}_2\text{O}}$. The ω value of 0.49 was interpreted by him as definitely ruling out the hydride anion abstraction mechanism of Roček (which like carbonium ion reactions would demand a negative value of the order > -2 for ω). The ω value was thought to reflect a mixed mechanism involving (i) the fast equilibrium formation of chromate ester which would have a positive ω value and (ii) the cyclic decomposition of the ester with a likely negative value for ω .

We had earlier proposed a modified hydride-anion-abstraction mechanism simulating the $\text{S}_{\text{N}}2$ reactions, involving a H_2O molecule in the transition state which was pictured as follows⁷:



The substituent and solvent influences were in full accord with the above transition state. The above analysis of the effect of change in

medium acidity on the rate provides additional evidence in favour of our mechanism.

Since the most important bond-breaking process in the above mechanism involves the loss of secondary hydrogen atom as a hydride anion the reaction could be expected to have a large negative ω value, as has been observed in several representative cases involving the formation of carbonium ions. A reaction which involves the participation of a molecule of water as a nucleophile in the rate-determining step (such as the acid catalysed hydrolysis of carboxylic amides and ethers) has been shown to have a large positive ω value between +1.2 to +3.3 while if the function of the water is as a proton transfer agent, the value of ω is greater than +3.3.

We deduce therefore that the ω value of +0.49 observed by Kwart arises out of the combination of two competing steps of opposite character as envisaged in our mechanism. The large negative value of ω characteristic of the developing carbonium ion character in the transition state would be offset by the nucleophilic participation of a water molecule in the transition state (with ω positive) with a resultant low ω value. The above mechanism thus simulates an $\text{S}_{\text{N}}2$ mechanism leaning considerably toward $\text{S}_{\text{N}}1$. And low ω values are characteristic of such reactions as glycoside hydrolyses and the acid catalysed oxygen exchange in butanol-2.⁸ It is also noteworthy that the Zucker-Hammett slope of 0.91 in the alcohol oxidation is very nearly the same as that observed (slopes of 1.02 and 0.97 in plots of $\log k$ vs. H_0) in the above reactions.

Dept. of Chemistry, N. VENKATASUBRAMANIAN.
Vivekananda College,
Madras, December 6, 1965.

1. Roček, J. and Krupicka, J., *Coll. Czech. Chem. Comm.*, 1958, **23**, 2068.
2. Graham, G. T. E. and Westheimer, F. H., *J. Amer. Chem. Soc.*, 1958, **80**, 3030.
3. Taft, Jr. R. W., Deno, N. C. and Skell, P. S., *Annual Review of Physical Chemistry*, 1958, **9**, 306.
4. Kwart, H., Goodman, A. L., *J. Amer. Chem. Soc.*, 1960, **82**, 1947.
5. —, *Suomen Kemi*, 1961, **34**, 173.
6. Bunnett, J. F., *J. Amer. Chem. Soc.*, 1961, **83**, 4956.
7. Venkatasubramanian, N., *Ind. J. Chem.*, 1963, **1**, 48.
8. Bunton, C. A. and Jewell, D. R., *J. Chem. Soc.*, 1957, p. 3402.

BROMATOMETRIC ESTIMATION OF PEONOL

PHENOL and resorcinol are readily and quantitatively tribrominated by the Koppeschaar's method¹ but substituted phenols yield erratic results³⁻⁵ and the course of bromination could not be predicted. The factors controlling quantitative bromination are: (1) nature and position of the substituent in the phenol, (2) amount of bromine added in excess, (3) temperature and (4) acid concentration.

Neelakantam and Viswanath⁷ investigated the estimation of resacetophenone by Koppeschaar's method and found that the actual titre value for dibromination could be obtained only by a method of extrapolation to zero excess of bromate. The procedure involved a series of titrations in each case and the maximum error was as much as 5%. Ramanujam,⁸ however, successfully employed methyl orange to indicate the end point in the direct bromatometric titration of resacetophenone in which dibromination occurred. The present investigation deals with the quantitative bromination of peonol (4-methyl ether of resacetophenone) by: (1) Koppeschaar's method and (2) direct titration with methyl orange as indicator.

EXPERIMENTAL

Peonol was prepared by Roger Adam's² method. The product was purified by vacuum distillation. Large transparent crystals, m.p. 50° C.

Standard solution of peonol was prepared by taking accurately weighed quantities, dissolving in 50% alcohol and making up to known volume with the same solvent.

Koppeschaar's Method

A measured volume of a standard solution of peonol was placed in an iodine flask provided with a wide lip, acidified with hydrochloric acid (1:1) to yield a final acid concentration of 1.0 N and treated with a measured volume (excess) of standard bromate-bromide mixture (0.0989 N) from a burette. The flask was stoppered and gently shaken for 10 to 15 minutes. A 10% aqueous solution of potassium iodide was placed in the lip and the stopper gently loosened. After introducing sufficient amount of iodide the stopper was lifted up and washed with water. The iodine liberated was titrated with standard thiosulphate (0.0989 N) using starch solution as indicator. The excess bromate was calculated in each case.

A series of experiments was carried out with definite amounts of peonol. In each case the volume of brominating mixture initially added was varied and the excess determined. The data obtained are recorded in Table I. The bromate (ml.) initially added was plotted against the actual excess in each experiment and by extrapolation to zero excess the bromate equivalent of peonol was determined (cf. Table I, column 4). The amount of peonol was calculated on the basis of dibromination. The results obtained are recorded in Table II.

TABLE I

Peonol (mg.)	Bromate (0.0989 N) (ml.)		
	Added	Excess	Equivalent
6.88	5.0	3.0	1.7
	10.0	7.7	
	15.0	12.25	
13.75	5.0	1.4	3.1
	10.0	6.0	
	15.0	10.8	
	20.0	13.5	
34.38	15.0	5.1	8.3
	20.05	8.5	
	25.0	12.5	
68.76	25.0	5.8	16.64
	30.0	9.0	
	35.0	12.4	

TABLE II

Peonol (mg.)		Error (%)
Taken	Found	
6.88	6.98	+1.6
13.75	13.95	+1.5
34.38	34.07	-0.9
68.76	68.13	-0.9

Methyl Orange Method

A measured volume of standard peonol solution was acidified to yield a final concentration of 1.0 N with hydrochloric acid, methyl orange added, and directly titrated slowly and with constant shaking with standard bromate (0.0497 N) until the colour of the indicator was just discharged (end point). A few more drops of the indicator were added to confirm the presence of free bromine. The indicator correction was found to be 0.1 ml. and this was deducted from the actual titre values.

Typical results are given in Table III.

The results calculated on the basis of monobromination are reported in Table IV.

TABLE III

Peonol mg.	Bromate (0.0497 N) ml.
8.19	1.95
16.37	3.95
40.94	10.10
81.87	20.25

TABLE IV

Peonol (mg.)		Error (%)
Taken	Found	
8.19	8.44	-1.78
16.37	16.29	-0.48
40.94	41.67	+1.9
81.87	83.56	+2.0

In Koppeschaar's Method peonol undergoes dibromination and the results are accurate to within $\pm 2\%$ or less with amounts ranging from 7.0 to 70.0 mg. and with larger amounts the results are erratic. In the direct titration method using methyl orange as indicator, however, peonol undergoes only monobromination. The errors are negative with smaller amounts of peonol and become more positive with larger amounts. The results are accurate to within $\pm 2\%$.

The author expresses his thanks to Prof. K. Neelakantam for his kind interest in the work.
Department of Chemistry, G. RAJA REDDY.
S. V. University College,
Tirupati, November 23, 1965.

1. Koppeschaar, *Zeit. Anal. Chem.*, 1876, **15**, 234.
2. Roger Adams, *J. Amer. Chem. Soc.*, 1919, **41**, 260.
3. Francis, A. W. and Hill, A. J., *Ibid.*, 1924, **46**, 2498.
4. Day, A. R. and Taggart, W. T., *Ind. Eng. Chem.*, 1928, **20**, 545.
5. Mayer, *Nachweis und Bestimmung Organischer Verbindungen*, 1933 **2**, 231.
6. Rudermann, *Ind. Eng. Chem., Anal. Ed.*, 1946, 753.
7. Neelakantam and Viswanath, *Proc. Ind. Acad. Sci.*, 1952, **35A**, 72.
8. Ramanujam, *J. Sci. & Ind. Res.*, 1955, **14 B** (11), 564.

SPECTROPHOTOMETRIC STUDIES OF URANIUM (VI) 3-BENZYL-4, 5-DIHYDROXYCOUMARIN COMPLEX

3-BENZYL-4, 5-dihydroxycoumarin has been used for the spectrophotometric determination of Ti(IV),¹ thereby lending support to Sommer's conclusion that ortho- and peri-dihydroxy compounds are chromogenic reagents for Ti, V, Mo and uranium.² The present communication deals with the study of this compound as a spectrophotometric reagent for uranium (VI).

An ethanolic solution of this reagent produces with uranium solution an orange coloured complex, soluble in 40% ethanol. The complex has a molar composition of 1:1 and obeys Lambert-Beer's law, at 410 m μ , upto 36 ppm of uranium in solution.

Experimental.—3-Benzyl-4, 5-dihydroxycoumarin was prepared by Trivedi's method as already reported,¹ and its ethanolic solution was used. A standard solution of uranium (VI) was prepared by dissolving uranyl nitrate (Analar BDH) in double distilled water. Beckman pH meter model H 2 was used for pH measurements, and dilute solutions of sodium hydroxide and hydrochloric acid for pH adjustments and Unicam spectrophotometer model SP 600 for spectrophotometric measurements.

The orange coloured complex showed no absorption maximum in the visible region. The studies of the complex were, however, carried out at 410 m μ , as at this wavelength the molar extinction coefficient of the reagent is only 0.04×10^3 whereas that of the complex is 2×10^3 .

Minimum amount of the reagent necessary for full colour development was found to be four times that of uranium. During subsequent studies, the molar ratio of the reagent to uranium was, however, maintained at six.

The optical density measurements of the complex at different pH showed that the complex exhibited maximum absorption at pH 3.9-4.1. Subsequent studies were, however, carried out at pH 4.0.

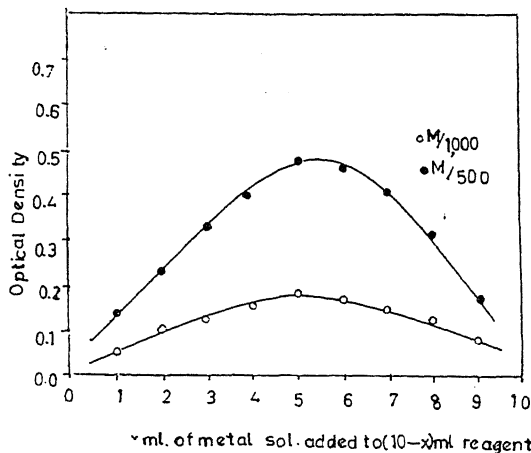


FIG. 1

The molar composition of the complex has been found to be 1:1 by (a) the continuous variation method³ (Fig. 1), (b) slope-ratio

method⁴ and (c) the straight line method⁵ (Fig. 2). On the basis of its molar composition

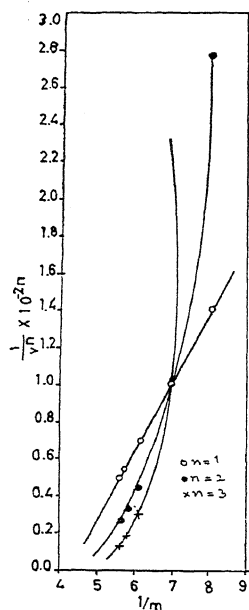
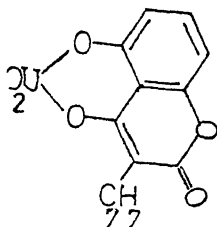


FIG. 2.

the following tentative structure may be assigned to the complex.



The optical density of the complex was found to be constant for twenty-four hours and it obeyed Lambert-Beer's law, at 410m μ , upto 36 ppm of uranium in solution (Fig. 3). Stability constant of the complex was determined spectrophotometrically. Two solutions having different ratios of uranium and the reagent, but with constant ionic strength (0.4 M, maintained by adding sodium perchlorate solution) and containing 40% ethanol were so prepared that their optical density was either equal or approximately equal. The dissociation constant of a given pair of reactants remaining the same and the molar composition of the complex being 1:1, the concentration of the complex and hence the value of K may be calculated from the relation

$$K = \frac{[MK_e]}{[M][K_e]}$$

where $[MK_e]$ denotes the concentration of the complex, $[M]$ and $[K_e]$ that of the metal ion and the ligand respectively. The stability constant was also calculated from the dissociation constant of the complex, found from the intercept made by the straight line in the Asmus method.⁵ The average value of log K as determined by the above methods was found to be 5.0 ± 0.2 at 20–22°C. in 40% ethanolic solution.

Interference due to Foreign Ions.—Cerium, thorium, titanium, iron and molybdenum, even when present in minute amounts, were found to interfere seriously, as these metals themselves form coloured complexes with the ligand. Among the anions, nitrate, chloride, iodate and thiocyanate did not cause interference even when present upto three times the amount of uranium. The presence of sulphate, thiosulphate and oxalate caused serious interference.

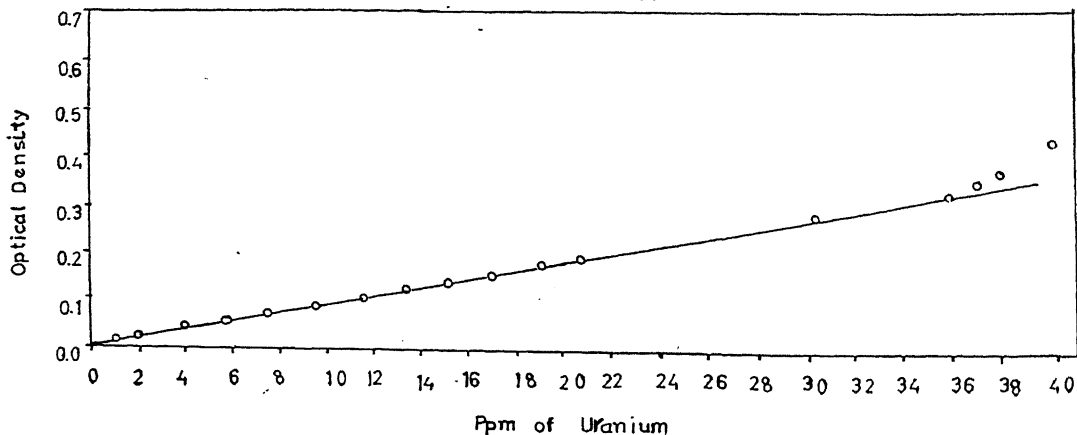


FIG. 3

Recommended Procedure for Estimation: An aliquot of the solution, containing not more than 36 ppm of uranium (VI), is mixed with the requisite amount of the reagent. The pH of the resultant solution is then adjusted to 4.0 and its optical density measured against the reagent. Concentration of uranium is then read from a standard calibration curve. Co, Th, Ti, Fe and Mo should be absent.

The authors are grateful to Prof. T. R. Seshadri, F.R.S., for his keen interest and helpful discussions.

Department of Chemistry, B. D. JAIN,
University of Delhi, RAJ KUMAR
Delhi-7, December 2, 1965.

1. Jain, B. D. and Raj Kumar, *Proc. Ind. Acad. Sci.*, 1964, **60**, 265.
2. Sommer, L., *J. anal. Chem.*, 1962, **187**, 7.
3. Job, P., *Jen. Chem.*, 1928, **9**, 113.
4. Harvey, A. F. and Manning, D. L., *J. Amer. Chem. Soc.*, 1950, **72**, 4188.
5. Asmus, E., *J. anal. Chem.*, 1960, **178**, 104.

DETERMINATION OF PALLADIUM AND NICKEL IN THE PRESENCE OF EACH OTHER

ONLY a few organic reagents are known for the separation and determination of palladium and nickel. Undoubtedly the most important amongst these contain the oxime group. Dimethylglyoxime,¹ noxime,² 4-methyl noxime,³ 4-isopropyl noxime⁴ and α -furildioxime^{3,4} have been recommended for this purpose. Diallyldithiocarbamido hydrazine⁵ (Dalmaz) has also been suggested for the separation and determination of these two metal ions when present together. Noxime is a good reagent for the gravimetric determination of palladium, but for the determination of nickel an empirical factor is required.⁶ In the case of α -furildioxime, nickel can only be separated but not estimated owing to the presence of two complexes formed together.⁷

In earlier communications, the range of quantitative precipitation for nickel⁸ and gravimetric determination of palladium⁹ and its separation from other metal ions, using 2-hydroxy- α -methyl-propiophenone-oxime (H.M.P.O.) were reported. The present studies have been carried out making use of the difference in pH's of quantitative precipitation of the two ions for achieving the separation. Palladium is precipitated at pH 3.0 and nickel is determined in the filtrate at pH 9.0.

Solutions of palladium chloride (Johnson Matthey) and nickel sulphate (AnalaR, BDH)

were prepared and standardized by D.M.G. method.¹⁰ A 0.5% (w/v) solution of the reagent (H.M.P.O.) was prepared in 95% ethanol.

The solution containing the two ions in question is taken and its pH adjusted to 3.0 in a total volume of 150 ml. Only palladium is precipitated as a yellow complex under these conditions. The precipitation is carried out from hot media (80°C). Just a little more than the stoichiometric ratio of the reagent is required. Large excess of the reagent is to be avoided as it tends to co-precipitate with the complex. The precipitate is digested on a water bath for 30 minutes. It is then filtered hot through a sintered glass crucible (G 4) and washed with 70% hot ethanol and finally with hot water. The precipitate is dried between 120-140°C. in an oven, to a constant weight. The conversion factor for palladium is 0.2301, the ratio of palladium: reagent in the complex being 1:2.

The filtrate is concentrated to a volume of about 75 ml. Excess of the reagent, if present in solution, gets precipitated and is filtered off. Ammonium chloride is added to the solution and the pH adjusted to 9.0 with ammonium hydroxide or hydrochloric acid in a total volume of 150 ml. The precipitation is carried out, as described above for palladium. The green complex is dried between 110-120°C. in an oven till a constant weight is obtained. The conversion factor for nickel is 0.1415, the ratio of nickel: reagent being 1:2 in the complex.

Results of separation and gravimetric determination of the two metal ions are incorporated in Tables I and II.

TABLE I
Estimation of palladium at pH 3.0

Weight of palladium taken mg.	Weight of nickel taken mg.	Weight of palladium complex mg.	Weight of palladium found mg.	% Error
4.035	31.28	17.5	4.026	0.10
8.070	25.00	35.0	8.053	0.21
12.105	18.75	52.5	12.080	0.26
16.140	12.50	70.2	16.153	10.08
20.175	6.25	87.5	20.133	0.20

TABLE II
Estimation of nickel at pH 9.0 (after removal
of palladium)

Weight of nickel taken mg.	Weight of palladium taken mg.	Weight of nickel complex mg.	Weight of nickel found mg.	% Error
31.28	4.035	221.4	31.32	10.22
25.00	8.070	177.2	25.07	10.28
18.75	12.105	133.0	18.81	10.32
12.50	16.140	88.8	12.56	10.48
6.25	20.175	44.4	6.28	10.43

The authors wish to express their thanks to Prof. T. R. Seshadri, F.R.S., for his interest in the work and to the C.S.I.R. (India) for financial assistance.

Department of Chemistry,
University of Delhi,
Delhi-7, December 9, 1965.

K. C. TRIKHA.
SHRI PRAKASH.
R. P. SINGH.

1. Golbraikh, Z. E., *J. Gen. Chem. (USSR)*, 1944, **14**, 810.
2. Vogel, A. I., *A Text-Book of Quantitative Inorganic Analysis*, 3rd Ed., E.L.B.S. and Longmans, Green & Co. Ltd., 1962, p. 126.
3. Soule, B. A., *J. Am. Chem. Soc.*, 1925, **47**, 981.
4. Ogburn, S. C., Jr., *Ibid.*, 1926, **48**, 2493, 2507.
5. Dutt, N. K. and Sarma, K. P. S., *Anal. Chim. Acta.*, 1960, **23**, 531.
6. Voter, R. C., Banks, C. V. and Diehl, H., *Anal. Chem.*, 1948, **20**, 453.
7. Reed, S. A. and Banks, C. V., *Proc. Iowa Acad. Sci.*, 1948, **55**, 267.
8. Prakash, S., Singh, H. and Gupta, M. P., *Jour. and Proc. Inst. Chem.* (Communicated).
9. —, Singh, R. P. and Trikha, K. C., *Talanta* (in Press).
10. Vogel, A. I., *A Text-Book of Quantitative Inorganic Analysis*, 3rd Ed., E.L.B.S. and Longmans Green & Co., Ltd., 1962, pp. 480, 512.

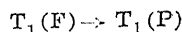
TETRAHEDRAL BIFORMATO BI(PYRIDINO) NICKEL (II)

THERE are relatively few authentic tetrahedral complexes of Nickel (II) known, and these are of recent origin.^{1,2} A tetrahedral Nickel (II) formate complex with pyridine has been prepared and studied. 500 mg. of Nickel (II) formate was suspended in 10 ml. of acetone. A little more than the calculated quantity of pyridine was added. The reaction mixture was refluxed for eight hours, filtered, washed several times with acetone and dried over P₂O₅. The complex is green in colour and soluble in formamide (Found Ni = 19.22%, N = 9.01%, C₅H₅N = 51.23%; C₁₂H₁₂O₄N₂.Ni, Calculated: Ni = 19.14%; N = 9.13%, C₅H₅N = 51.52%).

Conductivity measurements in formamide (conc. 10⁻³M) gives a value of 0.16 mhos, indicating the complex to be a non-electrolyte.³ Molecular weight, determined by the method outlined by the author,⁴ came out to be 293 (calculated = 306.7). These results suggest that the formate ions are also co-ordinated besides neutralising the charge on the metal. The formula of the complex is [Ni (HCOO)₂ (C₅H₅N)₂].

The visible absorption spectrum recorded on a unicam S.P. 500 spectrophotometer in formamide, indicated a single band (peak) at

800 mμ. The comparison of this with the spectra of other known tetrahedral complexes shows a fair agreement between the two.⁵ Further, the disappearance of 400 mμ band (peak) in the absorption spectrum is indicative of tetrahedral 4-co-ordination of Nickel (II).^{6,7} This band is associated with the following transition.



Chemistry Department, GOPAL NARAIN.
Lucknow University,
Lucknow (U.P.), India, November 8, 1965.

1. Lingafelter, E. C., *Nature*, 1958, **182**, 1730.
2. Sacconi, L. and others, *Proc. Chem. Soc.*, 1962, p. 255.
3. Nyholm, R. S., *J. Chem. Soc.*, 1957, p. 1714.
4. Gopal Narain and others, *J. Prakt. chemie*, in press.
5. Cyton, F. A. and Wilkinson, G., *Advanced Inorganic Chemistry*, Interscience Publishers, 1962, pp. 736-737.
6. Katzin, L. I. and Lingafelter, E. C., *Nature*, 1959, **183**, 1672.
7. Miss Padmaja Shukla and Gopal Narain, *Bull. Chem. Soc., Japan* (communicated).

CHEMICAL EXAMINATION OF THE FLOWERS OF *NELUMBIUM* *SPECIOSUM* WILLD.

Nelumbium speciosum Willd. (*Nelumbo nucifera* Gaertn.) is an aquatic plant belonging to the family *Nymphaeaceae* and commonly known as the 'sacred' lotus. The different organs of the herb are recorded to be useful as refrigerant, astringent, diuretic and cardiogenic.^{1,2} The leaves have been reported to contain an alkaloid, nuciferine³ and a glycoside of quercetin⁴ (quercetin 3-glucoglucuronide), and the flowers a kempferol glycoside⁵ (kempferol 3-galactorhamnoside). In view of the common use of the herb in indigenous medicine in South India, we have now chemically examined the flowers of both the red and white varieties of lotus.

The flowers (the white and red varieties) of *N. speciosum* were collected from ponds in Pondicherry during May-June and the petals, stamens and torus of each variety were extracted separately with hot methanol. The extracts were concentrated *in vacuo* to remove all the organic solvents with the addition of a little water towards the end, and the concentrate was shaken with petroleum ether to remove the waxy and carotenoid matter and ether in succession. Both the ether extract and the aqueous layer gave typical colour reactions for flavonoids. The concentrate from the ether extract on ascending and descending paper chromatography using Whatman No. 1 filter-paper

and different solvent systems showed the presence of quercetin and luteolin (confirmed by co-chromatography) in the case of petals and stamens, and quercetin only in torus. The aqueous extract on further concentration and study by paper chromatography and co-chromatography with authentic samples showed the presence of isoquercitrin and glucoluteolin in the case of petals and stamens, while the torus was found to contain only isoquercitrin. Further confirmation was also obtained by hydrolysis of portions of aqueous extract with 7% sulphuric acid, when the corresponding aglucones, quercetin and luteolin were obtained from the respective fractions and the sugar was identified in each case as glucose only by paper chromatography and the osazone.

The leaves of the plant collected during the same period were found to contain only quercetin and isoquercitrin. The leaves also gave test for leuco-anthocyanidins, which were identified as leucocyanidin and leucodelphinidin by conversion into the corresponding anthocyanidin chlorides and by means of paper chromatography and absorption maxima.

It may be pointed out that both the red and white varieties of *N. speciosum* collected in this region contain the same anthoxanthin pigments in the different parts of the flowers. The earlier reports⁵ on the isolation of kempferol and its glycoside from the flowers of North India may be due to ecological and seasonal variations.

We thank Principal Dr. D. J. Reddy for kind encouragement during the course of our work.

Jawaharlal Inst. of S. NAGARAJAN.
Post-grad. Med. A. G. R. NAIR.
Edu. and Res., S. RAMAKRISHNAN.
Pondicherry-6, S. SANKARA SUBRAMANIAN.
November 19, 1965.

AN INDIRECT METHOD FOR THE DETERMINATION OF PYROPHOSPHATE AND EDTA

We have observed that ferric iron can be titrated at pH 1 with thiosulphate in presence of copper (II) salts as catalysts, either potentiometrically or using sulphosalicylic acid as indicator, in which thiosulphate is quantitatively oxidised to tetrathionate.¹ We have now investigated the feasibility of determining pyrophosphate, EDTA and similar complexing agents which combine with iron (III) under these conditions, by adding a known excess of iron (III) to a solution containing the ligand and determining the excess iron by titration with thiosulphate.

All chemicals used are of AnalaR quality.

To 10 ml. of 0.025 M iron (III) solution, 2 ml. of 0.2 N copper (II) sulphate or chloride solution and an aliquot of 0.01 M solution of pyrophosphate or EDTA is added. The pH of this solution is adjusted to 1 by adding dilute hydrochloric acid or sodium hydroxide as required, or by adding 30 ml. of sodium acetate-hydrochloric acid buffer of pH 1.09, the total volume being made up to 50 ml. The solution is titrated potentiometrically after 10 minutes with a standard solution of sodium thiosulphate using a bright platinum rod as indicator electrode and a saturated calomel half cell as a reference electrode. The break at the end point corresponds to only about 10 mV and if necessary a graph depicting $\Delta E/\Delta V$ vs. V . [volume of hypo] may be plotted which clearly indicates the end-point. Alternatively, the solution, after adjusting the pH, is heated to 60-70°C and titrated with thiosulphate using 2 ml. of 1% sulphosalicylic acid to serve as an indicator. The change at the end-point will be from red to virtually colourless. In the case of pyrophosphate, a precipitate is obtained in the solution and the detection of the end-point requires some practice. A blank is conducted without the complexing agent and the amount of iron (III) bound by the reagent is calculated from which the concentration of either pyrophosphate or EDTA is obtained. The titres agreed with the theoretical values to within $\pm 0.5\%$.

From the titres, it is found that the reaction between iron (III) and pyrophosphate at pH 1 yields a product containing iron (III) and pyrophosphate in the ratio 4:3 suggesting the formula $Fe_4(P_2O_7)_3$ for the product. A similar observation has been made by Rogers

1. Chopra, R. N., Chopra, I. C., Handa, K. L. and Kapur, L. D., *Chopra's Indigenous Drugs of India*, U. N. Dhur and Sons Private Ltd., Calcutta, 1958, p. 679.
2. Nadkarni, A. K., *Indian Materia Medica*, 3rd ed., Popular Book Depot, Bombay, Vol. I, p. 844.
3. Arthur, H. R. and Cheving, H. T., *J. Chem. Soc.*, 1959, p. 2306.
4. Nakaoki, T., Morita, N., Nagata, Y. and Oguri, H., *J. Pharm. Soc. Jap.*, 1961, 81, 1158.
5. Rahman, W., Ilyas, M. and Khan, A. W., *Naturwiss.*, 1962, 49, 327.

and Reynolds in their potentiometric, conductometric and polarographic studies on the reaction between pyrophosphate and various cations.² Accurate values for pyrophosphate are obtained in the presence of orthophosphate also, provided its concentration is not more than 0.02 millimoles in the titration mixture. Even when the amount of pyrophosphate taken is only 0.02 millimoles, it can be determined accurately in presence of 0.02 millimoles of orthophosphate. This shows that the present method is very useful in establishing the purity of pyrophosphate samples. EDTA is found to yield a soluble 1 : 1 complex with iron (III). In this case it is necessary to have an iron (III) concentration which is at least five times that of EDTA for accurate values.

Attempts to determine other complexing agents like phosphate, oxalate, citrate and fluoride by a similar procedure are not successful because of lack of any proportionality and stoichiometry between iron (III) and the reagent.

One of us (B. V. S.) is thankful to the Council of Scientific and Industrial Research (India) for the award of a Research Fellowship.

Dept. of Chemistry, V. PANDU RANGA RAO.
Andhra Univ. Colleges, B. V. S. SARMA.
Waltair, November 22, 1965.

1. Pandu Ranga Rao, V. and Sarma, B. V. S., Unpublished work.
2. Rogers, L. B. and Reynolds, C. A., *J. Am. Chem. Soc.*, 1949, **71**, 2081.

STEARIC ACID FROM LEAVES OF *DAPHNE OLEOIDES* SCHREB.

MATTI¹ *et al.* reported a number of triterpenes from leaves of *Daphne cannabina* Wall. While searching for such triterpenes from leaves of *D. oleoides* we have isolated a good quantity of stearic acid from the petroleum ether extract.

1070 gm. of powdered leaves were extracted with petroleum ether (60–80°) wherefrom 75.3 gm. of residue was obtained. It was separated into acidic and neutral fractions. The acid fraction was esterified with diazomethane and chromatographed over alumina. This gave a low melting ester which could not be crystallised. It was hydrolysed to the free acid, m.p. 69°. It gave an anilide, m.p. 92° which did not depress the melting point of an authentic sample of stearic acid anilide. The acid was thus found to be stearic acid.

The neutral fraction from the petroleum ether extract was saponified and the non-saponifiable

matter was chromatographed. This yielded 60 mg. of β -sitosterol, m.p. 139–40° which was identified through its acetate, m.p. 131–32°.

In an assay experiment 100 gm. of powdered leaves were extracted with petroleum ether in a Soxhlet and the petroleum ether extract was shaken with 100 c.c. of 5% lead acetate solution. The mass was left overnight and the solid which separated in the interface was filtered. It was repeatedly washed with ether, then with water and finally dried and weighed as lead stearate (0.46 gm.). It corresponds to 0.33% stearic acid on the dry weight of leaves of *D. oleoides*.

Thanks are due to Dr. P. C. Maiti, Plant Chemist, for his keen interest in the work.

Chemical Unit, A. K. DAS.
Botanical Survey of India, Mrs. K. MUKHERJI.
Calcutta, November 26, 1965.

1. Maiti, P. C., Barua, A. K., Roy, A. K. and Sujata Roy, *Sci. and Cult.*, 1963, **29**, 160.

A NOTE ON THE RESPIRATION OF THE PILL-MILLIPEDE *ARTHROSPHERA DALYI* (POCOCK)

DURING the course of study on the activity of millipedes, it was found that the pill-millipede, *Arthrosphera dalyi*, exhibited a persistent diurnal rhythm. These pill-millipedes are very active during the night and inactive during the day when reared and tested at 28° C. in constant dark condition.¹ The earlier literature and recent reviews²⁻⁴ fail to mention any respiratory studies on millipedes. Hence it was considered worthwhile to study the respiration of these pill-millipedes occurring in Pazhamudir Solai of Alagarkoil Hills. The O₂ uptake of *A. dalyi* was estimated at one hour intervals through 24-hour periods using a Barcroft differential respirometer. 15% KOH was used as CO₂ absorber.

The O₂ uptake of *A. dalyi* through a 24-hour period is given in Table I.

The oxygen consumption like the locomotor activity¹ shows a diurnal variation. The oxygen uptake is high between 5 p.m. and 1 a.m. and low during the rest of the 24-hour period. The mean O₂ uptake between 1 a.m. and 5 p.m. is 3.4 μ l./gm./hr., whereas between 5 p.m. and 1 a.m. it is 5.4 μ l./gm./hr. This pattern of O₂ uptake was found to recur in the consecutive days also, provided the millipedes are not starved for more than four days. This pattern of O₂ consumption is similar to the locomotor activity.¹ However, the highest O₂ uptake is found between 5 p.m. and 1 a.m., whereas the

TABLE I

Oxygen consumption of *Arthrosphera dalyi* (Wet weight 1.435 gm.)

Time	12 Noon	1 p.m.	2	3	4	5	6	7	8	9	10	11 p.m.
Rate of O ₂ uptake mm. ³ /gm./hr. ..	3.411	2.48	3.101	3.411	3.101	3.711	4.963	4.963	5.893	5.893	5.893	5.893
Time	12 midnight	1 a.m.	2	3	4	5	6	7	8	9	10	11 a.m.
Rate of O ₂ uptake mm. ³ /gm./hr. ..	4.651	4.651	3.411	3.411	3.411	3.411	3.411	3.711	3.711	3.711	3.411	3.411

locomotor activity extends even up to 6 a.m. in the morning.

Further, it is evident that the O₂ uptake of pill-millipede is very low when compared with other arthropods. Even the diapausing pupæ of *Platysamia cecropia*⁵ and *Antheraea pernyi*⁶ consume oxygen more than three times that of the pill-millipede. Only a few sedentary coelenterates show such a low oxygen consumption.² It is not clear whether the pill-millipedes are able to utilise the stored carbohydrates or other substrates are involved in their respiration.

I wish to thank Prof. S. Krishnaswamy for his guidance and helpful suggestions.

Department of Zoology, A.L. PAULPANDIAN.
University of Madras,
Madurai Centre,
Madurai-2 (S. India), October 26, 1965.

1. Paulpandian, A.L., *Proc. Ind. Acad. Sci.*, 1965, **62**, 235.
2. Dittmer, D. S. and Grebe, R. M., *Handbook of Respiration*, W. B. Saunders Co., 1958.
3. Prosser, C. L. and Brown, F. A., *Comparative Animal Physiology*, W. B. Saunders Co., 1961.
4. Bliss, D. E. and Skinner, D. M., *Tissue Respiration in Invertebrates*, The American Museum of Natural History, New York, 1963.
5. Schneiderman, H. A. and Williams, C. M., *Biol. Bull.*, 1953, **105**, 320.
6. Waku, V., *Sci. Rept. Tohoku Univ.*, 4th Ser., *Biol.*, 1961, **23**, 143.

FOOD OF *PLANISPIRA NAGPORENSIS* PFEIFFER

The snail *Planispira nagporensis* is quite common in pools and puddles having good algal growth in Nagpur and its environs. The microscopical study of the intestinal contents showed algal spp. of *Oscillatoria*, *Pithophora*, *Aphanathece*, *Spirogyra*, *Euglena* and *Phacus*. It was therefore thought worthwhile to find out the algæ used as food by the snails. For this purpose triplicate sets, each set being of four snails, were maintained for each alga or algal mixture for seven days. The excreta were collected every day for detail microscopic examination to find out the effect on the algæ eaten by snails.

It was found that the snails ate all the algæ which they could gulp. Of the algæ tried, the snails did not eat Charophytes—spp. of *Chara* and *Lychnothamnus* as the plants were eight to ten cm. in height and hence too big to be gulped. These plants, when given after cutting them into small pieces, were readily eaten by the snails. It was found from the study of the excreta that the snails are able to digest only a few of the algæ tried and eaten by them. They are able to digest species of *Oscillatoria*, *Spirogyra* (veg.), *Ulothrix*, *Pithophora* (veg.), *Rhizoclonium*, *Oocystaenium*, *Characiosiphon* and germlings of *Nitella*. The excreta showed that there was no effect on the spp. of *Euglena*, *Phacus* and *Lepocinclis* as all these showed natural movement when freed from excreta. Species of *Cladophora*, *Chaetophora* (in small bits) *Oedogonium*, *Oedocladium*, *Cosmarium*, *Aphanathece*, *Nostoc* were unaffected. Akinetes of *Pithophora*, oogonia of *Chara*, zygospores of *Spirogyra* and spores of *Hapalosiphon* were found in the excreta unchanged. Species of *Dichotomosiphon*, *Hapalosiphon* (veg.) and cuttings of *Chara* and *Lychnothamnus* were found to be partially affected. The trichomes in the sheaths of *Microcoleus* and *Lyngbya* were mostly affected but the mucilaginous sheaths of these algæ were unaffected. It is worth mentioning that when a mixture of digestible and undigestible and partially digestible algæ like spp. of *Oscillatoria*, *Oedogonium* and diatoms were given as food, though the snails ate all algæ, the excreta showed unaffected filaments of *Oedogonium*, partially affected diatoms but no trace of *Oscillatoria*.

The snail therefore shows no selectivity in its feeding habit and hence the study of the intestinal contents does not give correct idea of its food as all the algæ eaten by the snails are not digested.

The author takes this opportunity to thank Shri J. H. Sabnis of the Department of Zoology for the kind identification of the snail.

Botany Department, N. D. KAMAT.
College of Science, Nagpur-1, January 24, 1966.

ON SOME GREEN ALGAE FROM THE
CHANNELS AND RESERVOIRS OF
SAURASHTRA SALT WORKS,
PORBANDAR

THE mile long channel at the Saurashtra Salt Works is 7.5 m. in width and 0.6–0.9 m. in depth. The channel is connected by estuarine streamlets with the sea; and the density of water in the channel is about 5° Baume, in January. There is inflow to the channel mainly during spring tides. *Cladophora crystallina*, *C. expansa* and *Enteromorpha plumosa* were found growing luxuriantly on soft silt at the bottom of the channel. *C. expansa* was found in the month of December 1963 and the other two species in January, 1964. *E. clathrata* was collected in January, 1964 from the edge of a large reservoir in the Salt Works. These species are described below, the descriptions being based on the present materials from Porbandar.

1. *Cladophora crystallina* (Roth) Kuetzing Pl. II, Figs. 1–4.

Tab. Phyc., 1854, t. 19, Fig. 2; De Toni, 1889, pp. 318–19; Taylor, 1957, p. 86; 1960, p. 58.

Plants faint green, soft but slightly coarse at the basal region, forming entangled masses; branching dichotomous in basal region, unilateral or sometimes whorled in the upper region; main branchlets 79–140 μ in diameter; ultimate branchlets 28–42 μ in diameter; cells 4–11.6 diameters long, non-constricted at nodes.

Specimen.—S. Kale No. 2, 27-1-1964, in Herbarium C.S. & M.C.R.I., Bhavnagar.

Geograph. Distrib.—Atlantic coasts of Europe and America, Mediterranean Sea, Canary Islands, West Indies.

2. *Cladophora expansa* (Mertens) Kuetzing Pl. I, Figs. 1–8.

Tab. Phyc., 1853, t. 99, Fig. 1; De Toni, 1889, p. 319; Boergesen, 1925, p. 68; Taylor, 1957, p. 85, pl. 5, Fig. 5; 1960, p. 85.

Plants light green with dark green tips, forming soft entangled spongy masses of about 0.6 m. in diameter and consisting of densely branched cylindrical filaments; branching alternate or divaricate in the lower region, unilateral in the apical region; main branches angled-flexuous; apical cells becoming longer than the other cells; cells of the larger axes 126–140 μ in diameter with length 3–5 times their diameters; cells in basal region with thick stratified walls.

Reproductive bodies in the cells grading from zoospores to aplanospores, spherical, with diameter 9–12 μ .

Specimen.—S. Kale No. 1, 20-12-1963, in Herbarium C.S. & M.C.R.I., Bhavnagar.

Geograph. Distrib.—Atlantic Coasts of Europe and America.

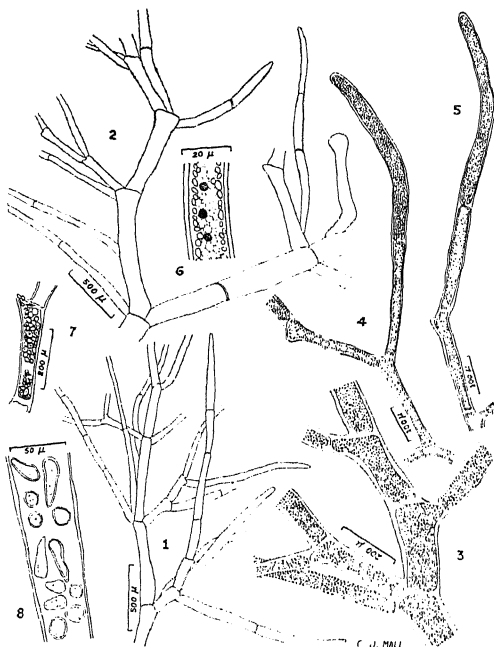


PLATE I

FIGS. 1–8. *Cladophora expansa*. Figs. 1–3. Upper, basal, and middle portions of plant, showing dichotomous branching. Figs. 4–5. Characteristic elongated terminal cells. Fig. 6. Part of young cell showing 3 nuclei and chloroplasts. Fig. 7. Discharge of zoospores through an opening in upper end of a cell. Fig. 8. Germination of spores inside a cell.

3. *Enteromorpha plumosa* Kuetzing Pl. II, Figs. 7–8.

De Toni, 1889, p. 32; Boergesen, 1925, p. 10; Taylor, 1957, p. 63; 1960, p. 58.

Plants solitary, attached, 7–25 cm. tall, yellowish-green, soft, branching repeatedly; branches delicate and irregular, in the basal region opposite or whorled, cylindrical, with long uniseriate tips; cells sub-rectangular, in branch tips 9–12 μ diameter, in longitudinal as well as transverse series, in main axis 12–21 μ wide, with length equal to the diameter, with chromatophores incompletely lining the cell face.

Specimen.—S. Kale No. 3, 27-1-1964, in Herbarium C.S. & M.C.R.I., Bhavnagar.

Geograph. Distrib.—Atlantic Coasts of Europe and America, Mediterranean Sea, West Indies, Malayan Archipelago.

4. *Enteromorpha clathrata* (Roth) J. Agardh. Pl. II, Figs. 5–6.

De Toni, 1889, p. 133; Boergesen, 1925, pp. 10–11; 1940, p. 9; Taylor, 1957, p. 63, pl. 3, Fig. 11; 1960, p. 58.

Floating adult plants 20-30 cm. long, light green, cylindrical and repeatedly branched; main axis 0.5-2.5 mm. in width; branches tapering from the base but not ending in uniseriate long tips; cells more or less in longitudinal series but somewhat irregularly disposed in basal region, sub-rectangular to polyhedral, 12-27 μ diameter, with length of cells in main axis two-thirds of their diameter and in branches $1\frac{1}{2}$ to 2 times the diameter.

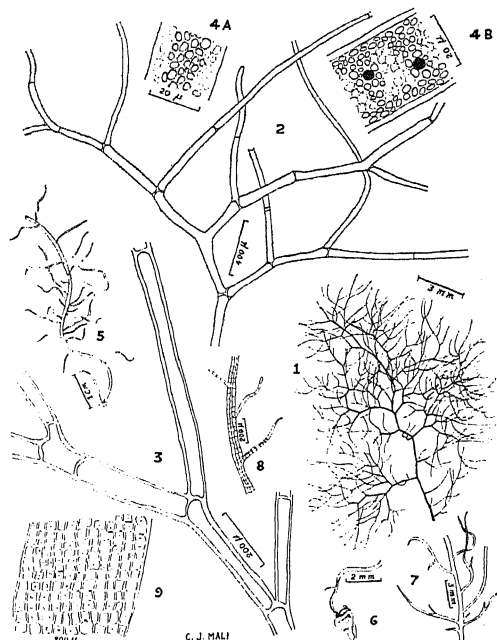


PLATE II

FIGS. 1-9. *Cladophora crystallina*. Figs. 1-4. *Enteromorpha clathrata*. Figs. 5-6. *E. plumosa*. Figs. 7-9. Fig. 1. Habit of portion of plant. Fig. 2. Second upper branchlets. Fig. 3. Dichotomous middle part of plant. Fig. 4 A. Surface view of part of cell showing chloroplasts. Fig. 4 B. Optical section of part of cell showing nuclei and chloroplasts. Fig. 5. Habit of a relatively young plant. Fig. 6. Holdfast. Fig. 7. Part of the plant showing spiral branching. Fig. 8. Part of the branch showing two young uniseriate ramuli and older ramulus with uniseriate tip. Fig. 9. Basal part of a branch, with cells in transverse and longitudinal rows.

Specimen.—S. Kale No. 4, 28-1-1964, in Herbarium C.S. & M.C.R.I., Bhavnagar.

Geograph. Distrib.—Atlantic Coasts of Europe and America, Mediterranean Sea, West Indies, Persian Gulf, Taiwan, New Zealand.

The author expresses her gratitude to Dr. D. S. Datar for kind encouragement and facilities, and to Dr. Francesca Thivy for guidance in the study.

Central Salt and Marine SUDHA KALE.

Chemicals Research Institute,
Bhavnagar, July 27, 1965.

1. Boergesen, F., "Marine algae from the Canary Islands, especially from Tenerife and Gran Canaria. I. Chlorophyceae, *Kongel. Danske Viden. Selsk.*" *Biol. Medd.*, 1925 5 (3), 1.
2. —, Some marine algae from Mauritius. I. Chlorophyceae, *Ibid.*, 1940, 15 (4).
3. De Toni, G. B., *Sylloge algarum omnium hucusque cognitarum*, 1 (*Sylloge Chlorophycearum*), 1889.
4. Kuetzing, F. T., *Tabulae Phycologicae, over Abbitdningen der Tange*, 1853, 3; *der Tange.*, 1854, 4.
5. Taylor, W. R., "Marine algae of the north-eastern coast of North America," *Univ. Michigan Stud., Sci. Ser.*, 1957, 13.
6. —, Marine algae of the eastern tropical and subtropical coasts of the Americas, *Ibid.*, 1960, 21.

PARTHENIUM HYSTEROPHORUS

Parthenium hysterophorus Linn., an exotic weed of the family Compositae, was introduced into India only about a decade ago. It was first noted in the neighbourhood of Poona in 1958 in the form of stray plants on rubbish heaps (see Rao,¹ Santapau²). In 1961, it was recorded as a rare weed in Dharwar which is situated on the eastern fringe of the Western Ghats (see Ladwa and Patil³). By 1962, it had become the most abundant plant in the whole of Poona along roadsides, in waste places, by the sides of canals, railway lines, etc. In September 1964, I found stray plants growing near settlements in Moti Bagh and on the Delhi Ridge. This is, therefore, the first record of the species occurring outside the Poona and Dharwar region. A second visit in October 1965 showed a very high numerical increase of the plant, especially in construction plots near Moti Bagh and Vinay Nagar. Specimens collected from different parts of Delhi have been conserved in the Department of Botany, University of Delhi, Delhi. The weed is spreading at a fast rate growing mostly in disturbed or unused land such as roadsides, footpaths, construction plots, etc. The only other species that grows in apparent competition is *Xanthium strumarium* Linn. It is said to be controlled by fire or by mowing close to the ground as soon as the first flowers appear. Scattered plants can be destroyed by cutting the stem below the crown with a hoe or spud (see Muenscher⁴). During recent years, a good number of neotropical weeds have been found in the region of Delhi, of which the following deserve mention: *Acanthospermum hispidum* DC., *Alternanthera pungens* H.B. & K., *Gnaphalium purpureum* Linn., *Ximenesia encelioides* Cav. (syn. *Verbesina encelioides*

A. Gray), *Parthenium hysterophorus* Linn., *Eichhornia crassipes* (Mart.) Solms, *Gomphrena celosioides* Mart., *Erigeron bonariensis* Linn. (syn. *E. unifolius* Willd.), *Croton bonplandianum* Baill. (syn. *C. sparsiflorus* Morong.) and *Chenopodium ambrosioides* Linn. (see Maheshwari⁵). Many of them are highly undesirable and cause much damage. This note provides a botanical description of *Parthenium hysterophorus* Linn., together with illustrations of various parts of the plant.

Parthenium hysterophorus Linn. Sp. Pl., 988, 1753; Hill, *Veget. Syst.*, 3: t. 21, 1761; Descourtilz, *Fl. Pitt. & Méd. Antilles*, 6: t. 395, 1828; Hoffmann in Engler and Prantl, *Nat. Pfam.*, 4 (5): 114, 1889; Ramirez, *Dat. Mat. Med. Mexico*, 4: 150, 1907; Arechavaleta, *Fl. Urug.*, 3: 300, t. 59, 1908; Britton and Brown, *Ill. Fl. N. States and Canada* (ed. 2), 3: 465, 1913; Britton, *Fl. Bermuda*, 398, 1918; Muenscher, *Weeds* (ed. 2), 487, 1955; Rao in *J. Bombay nat. Hist. Soc.*, 54: 218, 1956; Gleason and Cronquist, *Man. Vasc. Pl. N.E.U.S. and Canada*, 691, 1963; Santapau in *Indian Fmg.*, 14: 23, 1964; Reed in *Phytologia*, 10: 338, 1964 (Figs. 1-7).

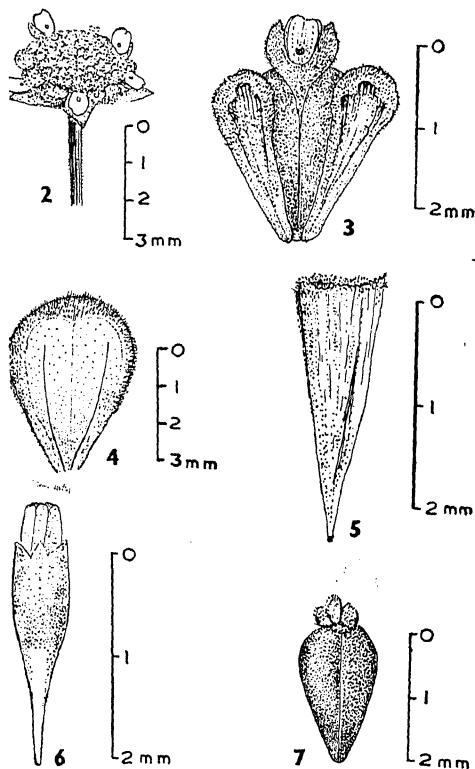
An erect, tufted, profusely branched, leafy herb, 1-1.2 m. tall. Stems hairy, scabrid, rigid, angular, longitudinally grooved. Leaves alternate, 2-8 cm. long and up to 5 cm. broad, pinnately or bipinnately dissected; segments linear, entire, thin-textured; smaller and undivided in the region of the inflorescence or with one to two, minute, lateral lobes and a linear, terminal segment.

Capitula 4-5 mm. in diam., heterogamous, numerous, peduncled, in an axillary or terminal, leafy, lax, corymb-like cymes. Involucre of usually five outer bracts followed by five inner bracts; the latter subtending a female floret with two male florets on either side; male florets in turn enclosed in a bract. Outer bracts ovate, acute, finely hairy in the upper two-third of margin, prominently nerved, about 2.5×1 mm.; inner bracts obovate, thin, transparent, up to 2 mm. long, margin lined by irregular filmy layers. Female florets jug-shaped, white; corolla cup-shaped with indistinct lobes enclosing style; stigma bifurcated, somewhat exserted; two appendages present at the junction of the lower and upper parts of the floret; ovule single, basal. Male florets developed in pairs along with five female florets on the ray, bracteate; bracts oblanceolate, thin, transparent, lined by irregular filmy layers, enclosing male florets, about 2×0.5 mm. Disc florets all male, yellowish,

about 1.5 mm. long; corolla infundibuliform, lobes distinct, acute, five; stamens five, syngenesious, exserted. Achenes obovate, black, up to 2×1 mm., crowned by the persistent remnants of corolla, appendages and style.



FIG. 1. *Parthenium hysterophorus* Linn.: Flowering twig.



FIGS. 2-7. *Parthenium hysterophorus* Linn.: Fig. 2. Capitulum. Fig. 3. Female floret with a pair of male florets in bracts. Fig. 4. Bract of female floret. Fig. 5. Bract of male floret. Fig. 6. Male floret. Fig. 7. Fruit.

The plant is native in tropical America, from Florida to Texas, locally north to Massachusetts, Pennsylvania, Ohio, Michigan, Illinois, Missouri and Kansas (see Gleason and Cronquist,⁶ Reed⁷). It has also been collected from the West Indies and some parts of South Africa. In India, the species has made further ingress in the northern parts. Apparently it had travelled about 1500 km. northwards to Poona and is likely to be seen in other parts of the country.

Common Name: Parthenium.

Flowering and Fruiting: August—December

Specimens collected.—Delhi Ridge, J. K. Maheshwari 5372, August 30, 1964; Moti Bagh, New Delhi, J. K. Maheshwari 5530, August 13, 1965 (Herb. Univ., Delhi).

The author thanks Prof. P. Maheshwari for his interest in this study.

Department of Botany, J. K. MAHESHWARI.
University of Delhi,
Delhi-7, December 7, 1965.

1. Rao, R. S. *J. Bombay nat. Hist. Soc.*, 1956, **54**, 218.
2. Santapau, H., *Indian Fmg.*, 1964, **14**, 23.
3. Ladwa, H. R. and Patil, R. M., *J. Bombay nat. Hist. Soc.*, 1961, **58**, 68.
4. Muenscher, W. C., *Weeds* (ed. 2), New York, 1955, p. 487.
5. Maheshwari, J. K., *Proc. Summer School of Botany*, Darjeeling, 1960-62, p. 159.
6. Gleason, H. A. and Cronquist, A., *Manual of Vascular Plants of Northeastern United States and adjacent Canada*, New York, 1963, p. 691.
7. Reed, C. F., *Phytologia* 1964, **10**, 338.

THE OCCURRENCE OF A MOSAIC DISEASE OF PHLOX IN INDIA*

DURING the winter of 1964, a few phlox plants in garden beds at the Indian Agricultural Research Institute, New Delhi, were found to be affected with a disease the symptoms of which suggested its possible virus nature.

The symptoms of the disease as observed in nature comprised of slight vein-clearing in the early stages followed by mosaic mottling of leaves. Mottling was of light and dark green colour alternating with each other. There was no deformation or distortion of leaf-lamina. Affected plants presented a little paler appearance amidst the dark green colour of the healthy plants. The symptoms were masked in summer.

The disease was easily transmissible to phlox as well as several other host plants, by rubbing method of sap inoculation using carborundum as an abrasive, indicating that it was of virus origin and the causal virus was sap-transmissible.

Incubation period of the virus in phlox varied from 10 to 12 days in winter (10–20° C.). Typical symptoms as observed in nature were reproduced.

Smith (1950) reported the occurrence of a mosaic disease of phlox from Cambridge. In 1952, he concluded that the virus was closely related to Cucumber mosaic virus. Faan and Johnson (1951) reported natural infection of Cucumber mosaic virus on *Phlox drummondii* Hook. in Wisconsin. Cucumber mosaic virus has also been reported infecting phlox from Denmark (Anon., 1962). From a study of host range and properties, the virus causing mosaic of phlox at Delhi resembles Cucumber mosaic virus (*Cucumis virus 1*, Smith). The present note forms the first record of a virus disease naturally occurring on phlox in India and also the first record of Cucumber mosaic virus on phlox from India.

The authors wish to express their grateful thanks to Dr. S. P. Raychaudhuri for encouragement and providing necessary facilities. The senior author is also indebted to the Department of Atomic Energy (Government of India) for awarding a scholarship.

Division of Mycology and H. L. KHATRI.
Plant Pathology, V. V. CHENULU.
Indian Agricultural Research Institute,
New Delhi-12 (India), November 2, 1965.

* Part of the thesis submitted by H.L.K. for the M.Sc. degree, I.A.R.I.

1. Anonymous, *Tidsskr. Planteavl.*, 1962, **66**, 545.
2. Faan, H. C. and Johnson, J., *Phytopathology*, 1951, **41**, 1001.
3. Smith, K. M., *J. R. hort. Soc.*, 1950, **75**, 350.
4. —, *Ibid.*, 1952, **77**, 19.

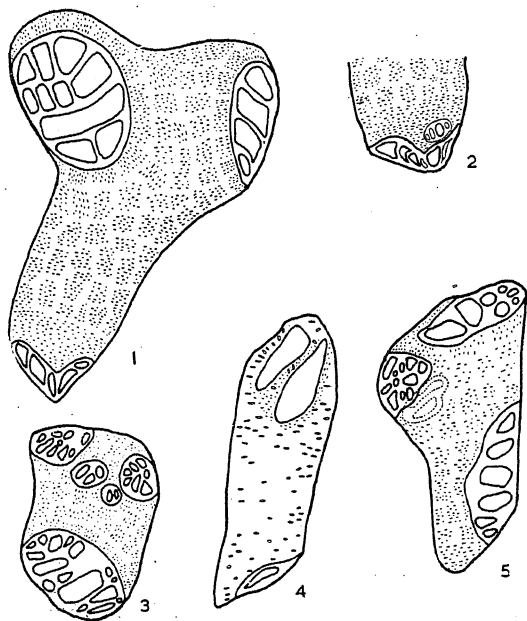
‡ Original not seen.

NODAL VESSELS IN DIOSCOREA ALATA L.

Dioscorea alata L. is an important commercially cultivated yam in northern and southern parts of Gujarat. Shah (1963)¹ reported multinucleate phase in vessel differentiation in *D. alata*. Recently Metcalfe and Ayensu (Metcalfe, 1964)² have expressed that their study in the anatomy of Dioscoreaceae is yielding results of great interest.

As far as we are aware there is no extensive work comparing the vessels in nodal region with those in the internodal part. Nodal vessels in *D. alata* differ from internodal ones in size, shape and nature, number, distribution and inclination of perforation plates. Some of

the vessel members have very peculiar characteristics. Dr. C. R. Metcalfe (personal communication) considers them as a special type, peculiar to *Dioscorea*, whose phylogenetic significance is too early to decide. The present note gives a short account of such interesting vessel elements.



FIGS. 1-5. Fig. 1. A nodal vessel element with one end branched; length, 648.0 μ ; diameter, 444.0 μ . Note the grouping of simple pits on the body wall, $\times 85$. Fig. 2. Details of perforation plate at the unbranched end of Fig. 1, forming three slopes, $\times 85$. Fig. 3. A vessel element with four perforation plates at one end and a single one at the other; length 460.0 μ ; diameter, 345.0 μ , $\times 41$. Fig. 4. A vessel element with two simple perforations at one end and a simple one at the opposite end; length, 219.0 μ ; diameter, 66.04 μ , $\times 177$. FIG. 5. A vessel element with four perforation plates; length, 271.4 μ ; diameter, 133.4 μ , $\times 150$.

Figure 1 shows a nodal vessel element with one branched end. One branch bears a scalariform perforation plate and the other a scalariform-reticulate one. The perforation plate of the unbranched end is obliquely placed along the three 'slopes' of the vessel ending (Fig. 2). There are simple pits on the body wall which show a distinct pattern of arrangement. It represents the positions of adjacent parenchyma cells. In Fig. 3 there are four perforation plates restricted to one end and a single transverse one at the other end of a short vessel element. The perforation plates are reticulate separated by simple pits. The body wall bears simple pits forming a pattern of grouping. Another variation seen in the nodal vessel ele-

ments is shown in Fig. 4, where there are two simple perforations on one end and one on the other end. Figure 5 shows a top-shaped nodal vessel element with a vertically oblique scalariform perforation plate on one end and three differently oriented perforation plates on the other. One of them, situated on the opposite face, is almost a simple perforation plate but for a single bar.

In addition to the above-mentioned types of nodal vessel elements, certain other differences between nodal and internodal vessels are observed. Irrespective of the types of perforation plates they are generally cylindrical. But many nodal vessel elements assume different shapes depending upon the number and orientation of perforation plates they bear. The internodal vessel elements with scalariform and reticulate perforation plates are quite long. The longest nodal vessel element of the above category is measuring to the average type of vessel element in internodal region. Vessel elements with simple perforation plates were observed in the node but were rare in the internode. The length of vessel elements with foraminate perforation plates does not show significant differences in nodal and internodal regions. In both cases they show angularities on the body wall. Scalariform, reticulate, simple and foraminate perforation plates are found in nodal and internodal vessel elements. Internodal vessel elements possess two perforation plates one on either end. Rarely one of the perforation plates may be quite away from the ends on the body wall. But a nodal vessel element may bear two to many, even eight perforation plates.

It is a matter of interest to note that Brauwer (1953)³ described the presence of tracheids in the node forming a wood complex in *Dioscoreaceae*, but in our observations in *D. alata* we have noted a number of peculiar vessel elements in the node.

Two of us (K. V. P. and K. U.) are grateful to the Ministry of Education, Government of India, for research scholarships.

University Dept. of Botany,
Sardar Vallabhbhai
Vidyapeeth,
Vallabh Vidyanagar,
Gujarat, November 22, 1965.

J. J. SHAH.
K. V. POULOSE.
K. UNNIKRISHNAN.

1. Shah, J. J., *Nature*, 1963, 197, 1125.
2. Metcalfe, C. R., *Notes from the Jodrell Laboratory—II*, 1964.
3. Brauwer, R., *Acta Botanica Neerlandica*, 1953, 2, 66.

EMBRYOLOGY OF *ELAEAGNUS* *CONFERTA* ROXB.

THE family, *Elaeagnaceae* is of taxonomic interest on account of its uncertain relationships. It has been considered by some systematists to be closely related to the *Thymelaeaceae* while others have included it in the *Rhamnales*. Our knowledge of the embryology of the family is scanty and the available information has been summarised by Schnarf.¹ As part of a research scheme on the morphological and embryological studies of some families and genera of disputed systematic position, the present investigation of *Elaeagnus conferta* Roxb. was undertaken and a brief account of the important results obtained is given here.

Elaeagnus conferta is a straggling shrub inhabiting the shady and moist areas around the swamps in the submontane tracts of Uttar Pradesh. A characteristic feature of the plant is the presence of scales that densely cover the young buds, branches, the lower surface of leaves, flowers and fruits.

The anther has four sporangia. The anther wall consists of the epidermis, a sub-epidermal layer which at maturity is organised into the endothecium with the characteristic fibrous thickenings, a middle layer and the tapetum. The tapetum is of the secretory type and its cells are 2-4-nucleate. The middle layer and the tapetum are disorganised in the mature anther. Both decussate and tetrahedral tetrads of microspores are found and the pollen is shed at the 3-celled stage.

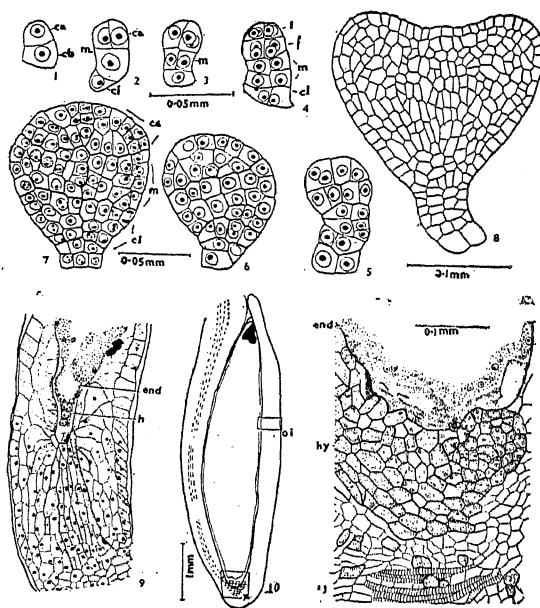
A single basal anatropous ovule is seen in the ovary. It is crassinucellate and bitegmic. An obturator of glandular cells is formed in the neighbourhood of the micropyle at the time when the mature embryo-sac has been organised inside the ovule. In the ovule a parietal tissue of 5-7 layers is developed and 1-3 megaspore mother cells may be differentiated in the nucellus. The development of the embryo-sac is of the *Polygonum* type. The antipodals are ephemeral. In the post-fertilisation stage, the endosperm consists of a large number of free nuclei which are found along the periphery of the large embryo-sac and an aggregation of nuclei in dense cytoplasm at the chalazal end. This part of the endosperm appears to possess a haustorial role which is evidenced by its encroachment on the prominent chalazal nucellar tissue (Fig. 9). A pad of hypostasic tissue is eventually formed at the base of the nucellar tissue which prevents further encroachment by the endosperm haustorium (Figs. 10-11). Wall formation in endosperm is initiated in the

micropylar end and this extends progressively towards the chalaza where, however, the free nuclear condition persists until its disorganisation.

The development of the embryo (Figs. 1-8) conforms to the 2nd megarchetype in the 1st group of the first grand period in the system of embryogenic classification of Souèges² or the Asterad type of Johansen.³

During the development of seed, the nucellus and the inner integument are crushed along the sides but the outer integument which initially consists of 5-7 layers of cells undergoes a remarkable expansion with the formation of 35-40 layers of cells in the mature seed. The seed-coat is thus formed by the outer integument alone. The fruit is a pseudodrupe with the perianth becoming fleshy and enclosing the ripened ovary.

Based on the above observations, it is concluded that the *Elaeagnaceae* are more closely related to the *Thymelaeaceae* than to the *Rhamnaceae*.



FIGS. 1-11. *Elaeagnus conferta* Roxb. Figs. 1-8. Stages in development of embryo (*ca*, *cb*, apical and basal cells of 2-celled embryo; *m*, *ci*, daughter cells of *cb*; *l*, *p*, superior and inferior octants; *A*₂ category of embryonic tetrad in Fig. 2. Fig. 9. L.S. of chalazal part of developing seed showing endosperm haustorium and prominent chalazal nucellar tissue. Fig. 10. Outline diagram of L.S. of a seed; portion marked 'X', enlarged in Fig. 11. Fig. 11. Chalazal part of seed with hypostase, free nuclei of endosperm and disorganised nucellar cells. (*end*, endosperm; *h*, haustorium; *oi*, outer integument; *hy*, hypostase; Figs. 9 and 11 are at the same magnification.)

The author thanks Dr. M. A. Rau for guidance and the Council of Scientific and Industrial Research for the award of a Junior Fellowship.

Botanical Survey of India, V. K. SHARMA.
Northern Circle, 63, Rajpur Road,
Dehra Dun, November 16, 1965.

1. Schnarf, K., *Vergleichende Embryologie der Angiospermen*, 1931.
2. Souèges R., *Embryogénie et classification*, 3c. Fasc., 1948.
3. Johansen, E. A., *Plant Embryology*, 1950.

CHROMOSOME NUMBER IN *APIS FLOREA*, FAB.

THE European hivebee, *Apis mellifica*, Linn., has a somatic complement of 32 chromosomes in female and 16 in male (Sanderson and Hall, 1948).

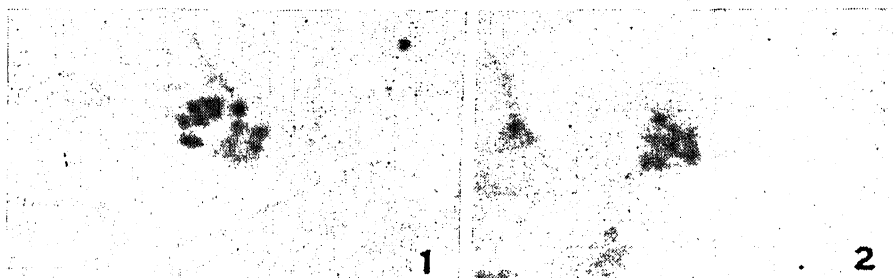
The Indian hivebee, *A. indica*, Fab., has the same chromosome constitution.^{4,7}

washed, dehydrated, embedded and sectioned at 12 μ and stained with iron-haematoxylin.

As is common with most of the Hymenoptera, there is no typical reduction during spermatogenesis. Both meiotic divisions are equational involving degeneration of one of the daughter nuclei cast away along with a small cytoplasmic bud.

Spermatogenesis in *A. florea* clearly shows presence of 8 chromosomes only. These counts were confirmed both during metaphase and anaphase. It is further confirmed from somatic anaphases in male during early embryonic divisions, before the inception of polysomaty (Figs. 1 and 2).

Presence of somatic complement of 8 in male and 16 in female suggests that *A. florea* is diploid relative to *A. mellifica* and *A. indica*, which carry twice these numbers. *A. florea* is, therefore, a primitive diploid member of the genus *Apis*, Linn. Its primitive status is also corroborated by its nest architecture (Thakar



FIGS. 1-2. Fig. 1. *A. florea*: Drone Egg—incipient anaphase showing 8/8 separation, $\times 5,000$ approx. Fig. 2. *A. florea*: Drone—Spermatogenesis, showing 8 chromosomes, $\times 5,000$ approx.

Karyotypic analysis of the somatic complement of 16 chromosomes in males of *A. indica*, showed the presence of 8 homomorphic pairs often showing somatic associations. It was therefore inferred that the male in *A. indica*, though numerically haploid, may be genetically diploid, the female being a tetraploid (Deodikar, Thakar and Shah, 1959). The possibility of occurrence of diploid species in the genus *Apis* was thus anticipated.

In order to explore this possibility, investigation on cytogenetics of other Indian honey bees, *A. dorsata* and *A. florea*, was taken up. Preliminary observations on *A. florea* are presented in this paper.

In view of the high prevalence of polysomaty in all *Apis* species, spermatogenesis presents reliable chromosome number. Various stages of spermatogenesis occur during the pupal stage. The abdominal segments carrying testes were truncated on both sides and fixed in Navaschin's fluid. The fixed material was

and Tonapi, 1962) as also its communication behaviour (Lindauer, 1957).

Central Bee Research C. V. THAKAR.

Institute, Poona-5.

Maharashtra Association for G. B. DEODIKAR.
the Cultivation of Science,
Poona-4, November 29, 1965.

1. Deodikar, G. B., *Bee Genet. Inf. Bull.*, 1960, 1, 15.
2. —, *Ibid.*, 1962, 3, 16.
3. — and Thakar, C. V., *Proc. Internat. Symp. "The Impact of Mendelism on Agriculture, Biology and Medicine"*, New Delhi, 1965.
4. —, — and Pushpa, N. Shah, *Proc. Ind. Acad. Sci.*, 1959, 49 B, 194.
5. Lindauer, M., "Communications between honey-bees and stingless bees of India," *Bee World*, 1957, 38, 3.
6. Sanderson, A. R. and Hall, D. W., *Nature*, 1948, 162, 34.
7. Sharma, G. P., Gupta, B. I. and Kumbkarni, C. G., *J. R. mic. Soc.*, 1961, 79, 337.
8. Thakar, C. V. and Tonapi, K. V., *Indian Bee J.*, 1962, 24, 27.

SEASONAL VARIATIONS IN THE ALKALOID CONTENTS OF *SOLANUM* *KHASIANUM* CLARKE

Solanum khasianum Clarke as described in the Flora of Assam¹ is a stout plant, about 1 metre high. Berries are yellowish and globose and about 2.5 cm. in diameter. The plant grows wild in Assam including Khasi Hills up to an altitude of 1,500 metres. They flower and bear fruits throughout the seasons.

The glycoalkaloid isolated from the berries was reported earlier from this laboratory² and characterised as solasodine in a yield of 0.7% on dry basis. Maiti *et al.*³ recently claimed to

precipitate was dissolved and precipitated once more in the same manner. The crude glycoside was dissolved and crystallised from 80% ethanol. Solasodine thus obtained along with additional crystals recovered from the mother liquor by subsequent treatments was hydrolysed at 100° C. for 3 hours in 100 ml. ethanol containing 20 ml. hydrochloric acid. The hydrochloride needles thus obtained were suspended in dilute ammonia solution at 100° C. for 1 hour. The aglycone, solasodine, was crystallised and recrystallised from 80% ethanol and weighed after drying in a vacuum oven. The melting and mixed melting points were undepressed (196-97° C.). The results are shown in Table I.

TABLE I

Showing the percentages of solasodine from *S. khasianum* berries on moisture-free basis collected at various fruiting stages of the seasons (average of two determinations)

I Season	II Fruiting stage	III Percentage of solasodine
20 December 1964	Green, mature	0.34
6 January 1965	Yellow, mature	0.47
11 February 1965	Deep yellow, over-mature	0.16
23 April 1965	Very green, pre-mature	0.39
15 May 1965	Green, mature	0.54
28 May 1965	Yellow, mature	0.57
26 June 1965	Deep yellow, over-mature	0.27
20 July 1965	Green, mature	0.38
3 August 1965	Yellow, mature	0.43
23 August 1965	Deep yellow, over-mature	0.30
15 September 1965	Very green, pre-mature	0.18
9 October 1965	Yellow, mature	0.52
3 November 1965	Deep yellow, over-mature	0.32

have isolated the alkaloid to the extent of 5.4% from *Solanum khasianum* Clarke var. *Chatterjeanum* Sengupta. On the other hand, Hamied⁴ found only 0.5% solasodine in the same variety of berries. Since our earlier work was based on the examination of green and yellow berries collected at random in July and August, a scheme of collection of fruits in various stages of development throughout the year and isolation of alkaloid was taken up. The results of isolation of alkaloid are given in this note.

The method of isolation is essentially the same as followed earlier. Berries from wild plants growing in the campus were collected, cut and dried in the sun or at a temperature of 50-60° C. and powdered. One kilogram of the sample was thoroughly extracted with ethanol. The extract was concentrated *in vacuo*. The semi-solid concentrate was dissolved in 3% acetic acid and filtered. The filtrate was basified with dilute ammonia. The

The results obtained by analysis of berries collected at suitable intervals under Jorhat climatic conditions indicate that the extractable solasodine contents vary with the fruiting stages, the maximum occurring in the green to yellow mature berries. Variations in the alkaloid contents due to seasonal effects are not very wide. However, the alkaloid obtained in the mature fruits collected in May was slightly more.

The authors wish to express their grateful thanks to Dr. M. S. Iyengar, Director, for his keen interest in the problem.

Regional Research Lab., S. B. CHAUDHURI.
Jorhat, November 8, 1965. J. N. HAZARIKA.

1. Kanjilal, U. N., Das, A., Kanjilal, P. C. and De, R. N., *Flora of Assam* Government of Assam, 1939, 3, 371.
2. Chaudhuri, S. B. and Rao, P. R., *Ind. Jour. Chem.*, 1964, 2, 424.
3. Maiti, P. C., Mookerjee, S., Mathew, K. and Henry, A. N., *Curr. Sci.*, 1964, 33, 731.
4. Hamied, Y. K., *Indian Drugs*, 1965, 2, 37.

REVIEWS AND NOTICES OF BOOKS

Moments Method in Applied Mathematics. By Yu. V. Vorobyev. (Russian Monographs and Texts on Advanced Mathematics and Physics). (Gordon and Breach, Science Publishers, 150, Fifth Avenue, New York 11, N.Y.), 1965. Pp. x + 168. Price \$12.50.

This book presents the theory behind the moment method of finding the eigenvalues of a linear operator approximately and of solving linear problems. The theory is illustrated by a number of specific applied problems.

The titles of the chapters contained in this book are as follows: I. Approximation of Bounded Linear Operators; II. Equations with Completely Continuous Operators; III. The Method of Moments for Self-Adjoint Operators; IV. Speeding Up the Convergence of Linear Iterative Processes; V. Solution of Time-Dependent Problems by the Method of Moments; VI. Generalization of the Method of Moments; and VII. Solution of Integral and Differential Equations.

This book will be found useful by research workers and post-graduates in the fields of applied mathematics, physics, and engineering, as well as by students in senior courses in corresponding specialties.

C. V. R.

Techniques for Electron Microscopy (2nd Edition). Edited by Desmond H. Kay. (Blackwell Scientific Publications Ltd., 24-25, Broad Street, Oxford), 1965. Pp. xiv + 560. Price 84 sh.

The sixteen chapters of this edition cover all aspects of electron microscopy. Most of the chapters have been rewritten and enlarged to cover the developments of the last four years. In particular the chapter dealing with the fixation and embedding of biological material has been enlarged to include the considerable improvements in fixation methods and the new resins that have become available for embedding. A completely new chapter has been written on the methods for section staining, cytology, autoradiography and immunochemistry. Another chapter deals with the technique of negative staining as applied to viruses, protein molecules and tissue fragments. In the case of non-biological material the methods for preparing transmission specimens and other materials by sectioning, thinning from bulk and vacuum

evaporation are covered in three chapters and a new chapter deals with the interpretation of micrographs of metal foils and other crystalline objects. Other chapters consider the operation of the electron microscope and its accessories, the preparation of support films, replica techniques, electron diffraction and reflexion electron microscopy. The book is essentially practical and deals with methods which have been proved to be of value in both research and industrial laboratories.

C. V. R.

Elements of Mechanics of Elastic Solids. By Lai and Saibel. (Addison-Wesley Publishing Company, Inc., U.S.A. and London), 1965. Pp. 196. Price \$7.75.

This sophomore-junior level book, requiring a course in statics and a course in calculus as background, is designed to be used as a basic text for a one-semester course in strength of materials. Its purpose is to provide the material which will enable the student to build a solid foundation for the understanding of continuum mechanics and its applications to important engineering problems. The book, therefore, covers such topics as the basic concepts of stress and strain, the laws of elastostatics, problems involving simple extension, torsion, and bending and buckling of structural members. The tensorial approach is emphasized so that the student can fully grasp the concept of stress and strain. While basic concepts and principles have been emphasized, ample problems and examples have been included in order to aid the student in acquiring the ability to analyse basic engineering problems. The authors have taken particular pains to ensure conciseness and clarity of presentation.

C. V. R.

Handbook of Preparative Inorganic Chemistry (Vol. 2) (Second Edition). Edited by Georg Brauer. (Academic Press, New York and London), 1965. Pp. xxiv + 857. (pp. 1003 1858). Price \$32.00.

Special experimental methods, techniques, and apparatus are presented together with detailed methods for preparation of inorganic compounds. For all the substances described, controllable and reproducible preparative conditions are given—all have been verified by laboratory experience. Important individual methods

found throughout the work are linked to the main techniques in the first section.

The description of compounds and elements is begun in Volume I and continued in the present volume. Most compounds of pedagogical and scientific interest are included; simple commercially available substances are omitted, as are very elementary and commonly known preparations. The references refer the reader to alternative and secondary methods and additional data. Special compounds are treated in the final section of the present volume.

Among the new features of the Second Edition, English translation, of this volume are: complete revision of several sections; inclusion of recently developed processes, methods, and apparatus; addition of new collaborators; bibliography corrected and brought up to date; revision of nomenclature and insertions of U.S. Trade names and suppliers; conversion of German glass and ground glass joint sizes to the U.S. equivalents; substitution throughout the text of "liquid nitrogen" for "liquid air"; adoption of the Stock and Stock-Werner systems; current U.S. usage reflected in references to laboratory equipment and techniques. C. V. R.

Dynamics of Chromatography (in three Parts):

Part I: Principles and Theory, by J. Calvin Giddings. (Marcel Dekker, Inc., 95 Madison Avenue, New York), 1965. Pp. xii + 323. Price \$11.50.

In this first of three parts series, Dr. Giddings discusses the underlying mechanisms of all forms of chromatography; gas and liquid chromatography will be dealt with in a more specific manner in the next parts. Though general in scope, this book is not limited to generalities; frequent reference is made to practical forms of gas and liquid chromatography and many numerical examples are used. Much of the material on the relationship of fluid flow and chromatography, the extensive random walk treatment, and many other items discussed have not appeared in the chromatographic literature before. This is not, primarily, a theoretical book designed to cast ideas into mathematics; it is more an interpretive work, the goal being to make physical sense of theoretical developments in the field.

The present volume is divided into roughly four sections: concepts of migration and zone spreading; non-equilibrium concepts; physical events which underlie chromatographic processes (flow, diffusion and kinetics); and separations. The author shows the common ground of

theory and practice and how the two may be combined with enormous benefits to both.

C. V. R.

Scientific Societies in the United States (Third Edition). By Ralph S. Bates. (The M.I.T. Press, Massachusetts Institute of Technology, Cambridge, Mass. 02142), 1965. Pp. 326. Price \$8.75.

In this new expanded third edition, the author has augmented his well-documented account of the development and function of American scientific societies with an important survey of the societies of the space age. The nuclear and space age has virtually replaced the lone working scientist with research teams. Government, industry, and universities commonly work together on major scientific projects, making the scientific society indispensable in its role of co-ordinator. Most of the scientific societies that have appeared in the last seven years are included in a new chapter, while minor revisions have been made in earlier chapters. A chronology of all the scientific societies in the United States has been added, and the bibliography has been enlarged considerably—bringing this important work completely up-to-date.

C. V. R.

Industrial Management in the Atomic Age. By Dean V. Lawrence Parsegian. (Addison-Wesley Publishing Company, Inc., U.S.A. and London), 1965. Pp. x + 374. Price \$10.75.

This book deals with the new problems of management which came into being with large government-sponsored technical projects. The most far-reaching changes came with the federal program involving the development of nuclear energy. The by-products and techniques of atomic energy had had wide impact on all science and technology, while the pattern for management of the atomic project has given example to other government agencies as well. The book traces the legislative, technological and regulatory history of these developments. It presents both the industrial opportunities, and the problems of managing activities in which the government retains licensing, contractual, production and financial authority.

The book under review came into being as a product of Dr. Parsegian's unusual experience with industrial and government activities, and as a result of teaching and modernizing courses in management and engineering at Rensselaer.

C. V. R.

Applied Optics and Optical Engineering (Vol. 2)—*The Detection of Light and Infrared Radiation*. Edited by R. Kingslake. (Academic Press, New York and London), 1965. Pp. xiii + 390. Price \$15.00.

The present volume under review contains the following articles: (1) The Eye and Vision, by Glenn A. Fry; (2) Stereoscopy, by Leslie P. Dudley; (3) The Photographic Emulsion, by Fred H. Perrin; (4) Combination of Lens and Film, by E. W. H. Selwyn; (5) Illumination in Optical Images, by Rudolf Kingslake; (6) Electro-optical Devices, by Benjamin H. Vine; (7) Television Optics, by Charles H. Evans; (8) Infra-red Detectors, by Henry Levinstein; (9) Infrared Equipment, by Charles F. Gramm.

The volume provides the precise data and information needed by an optical engineer in the design, construction, and testing of new optical devices.

C. V. R.

Mathematical Theory of Connecting Networks and Telephone Traffic (Vol. 17)—*Mathematics in Science and Engineering* (A series of Monographs and Text-Books. Edited by Richard Bellman.) Author: V. E. Benes. (Academic Press, New York and London), 1965. Pp. xiv + 319. Price \$12.00.

This volume is a systematic study of the combinational nature of communications networks, and of the traffic in them. Three kinds of traffic theory problems are considered: combinatorial problems of network design, probabilistic problems of traffic analysis (encompassing statistical problems of traffic measurement and analytical problems of calculation of the grade of service), and variational problems of routing traffic in networks. Emphasis is on basic concepts rather than engineering formulas, but practical problems always motivate the choices of topics. Special attention has been paid to the relevance of combinatorial properties of networks to their performance when carrying random traffic. This work will be found useful by applied mathematicians, communications systems engineers, and operations analysts.

C. V. R.

Advances in Heat Transfer (Vol. 2). Edited by T. F. Irvine and J. P. Hartnett. (Academic Press, New York and London), 1965. Pp. xi + 465. Price \$16.00.

This serial publication presents the continuing results of wide-spread research in the field of heat transfer. The recent increase of interest

in this field, created by the atomic energy industry and the aerodynamic and astronautic efforts, has led to the development of new instrumentation and experimental and analytical techniques. These innovations have resulted in definitive solutions to classical and complex problems which were previously attacked by approximation methods.

Advances in Heat Transfer publishes these new solutions and the results of the latest research and theory in the field. The review articles, written by outstanding authorities in their special areas, start with basic principles and develop topics in a clear and logical fashion. The articles, which serve as a broad review for experts in the field, will also be of great interest to non-specialists with only a general knowledge of the field who need to know the results of the latest research.

The topics included in the volume under review are: Turbulent Boundary-Layer Heat Transfer from Rapidly Accelerating Flow of Rocket Combustion Gases and of Heated Air, by D. R. Bartz; Chemically Reacting Non-equilibrium Boundary Layers, by Paul M. Chung; Low Density Heat Transfer, by F. M. Devienne; Heat Transfer in Non-Newtonian Fluids, by A. B. Metzner; Radiation Heat Transfer between Surfaces, by E. M. Sparrow.

C. V. R.

Deranged Memory: A Psychonomic Study of the Amnesic Syndrome. By George A. Talland. (Academic Press, New York and London), 1965. Pp. xi + 356. Price \$9.50.

This book represents an account of the most extensive investigation ever conducted with a group of patients in the chronic state of Korsakoff's Disease. The study, which examined over twenty patients on forty or more occasions, was designed to test specific hypotheses about disturbances characteristic of the amnesic syndrome and, indirectly, the processes involved in normal memory function. Hypotheses related to certain current theories of psychology and neurophysiology were subject to critical study.

The book includes: a review of the literature published in five languages on the psychopathology of the Korsakoff syndrome; data on the performance capacity of the patients in over 100 experimental tasks; critical examinations of confabulation in both chronic and acute phases of the amnesic syndrome; an empirical evaluation of certain explanatory models proposed by other investigators and by the author himself.

The book will be of interest to clinical and experimental psychologists, psychiatrists, neurologists, researchers in alcoholism, and those involved in legal and police sciences.

C. V. R.

Concepts from Tensor Analysis and Differential Geometry (2nd Edition): (Vol. 1)—*Mathematics in Science and Engineering—A Series of Monographs and Text-Books*. (Edited by Richard Bellman) by Tracy Y. Thomas. (Academic Press, New York and London), 1965. Pp. viii + 178. Price \$7.50.

This book presents basic concepts in concise form for students of pure mathematics and for those who apply tensor analysis and differential geometry to the mechanics of continuous media. An authoritative reference, this new edition covers: essential elements of tensor analysis; isotropic tensors—especially the fourth order; classical derivation of constitutive equations in elasticity and fluid dynamics; various ordinary spaces; Riemann spaces; illustrations of the application of the tensor concept; affinely connected spaces; theory of covariant differentiation; construction of differential invariants; curves and surfaces—especially parallel surfaces in the problem of wave propagation; Einstein-Riemann Spaces; timelike hypersurfaces and associated compatibility conditions; gravitational wave propagation in free space; the concept of proper volume; geodesic motion of isolated finite bodies.

C. V. R.

The Inflammatory Process. Edited by B. W. Zweifach, L. Grant and R. T. McCluskey. (Academic Press, New York and London), 1965. Pp. xvi + 931. Price: List Price \$36.00.

This book covers comprehensively both the morphologic and the dynamic aspects of the problem. It starts with a discussion of the experimental approach to the study of inflammation in which the emphasis is on the importance of a changing technology in providing new view-points about old problems. An attempt is then made to establish the morphologic basis of the problem as a prelude to a discussion of dynamic events and an analysis of the participation of white-blood cells in the inflammatory process, the roles of mast cells, chemical mediators, lysosomes, and hemostatic mechanisms lead to two general chapters on fever and wounded healing as expressions of inflammation, followed by a discussion of anti-inflammatory agents and their contributions to an understanding of inflammatory reactions.

The later chapters deal with the complexities of complement and the mechanisms of inflammation resulting from immunologic processes.

The volume can serve as an authoritative reference for graduate students and medical students, for experimental biologists, and for others who wish to examine the experimental background of current theories of inflammation.

C. V. R.

The Theory of Electron-Atom Collisions. By G. F. Drukarev. (Academic Press, New York and London), 1965. Pp. xi + 161. Price 39 sh. 6 d.

This volume originally written by G. F. Drukarev in Russian has been translated into English by S. Chomet.

Professor Drukarev presents a detailed discussion of the quantum theory of electron-atom collisions which includes important contributions on such treatments as perturbation theory, distorted wave calculations, variational methods, allowances for exchange and for coupling, together with improved computational techniques.

All this will be of interest not only to the professional quantum theorists, but also to those physicists who require merely to understand the effects produced by elastic and inelastic collisions, without personally manipulating the mathematics.

C. V. R.

Information and Prediction in Science. Edited by S. Dockx and P. Bernays. (Academic Press, New York and London), 1965. Pp. xi + 272. Price \$9.50.

This volume represents the Proceedings of a Symposium sponsored by the International Academy of the Philosophy of Sciences held at Chateau de Karreveld in Brussels, from 3rd to 8th September, 1962, to bring together scientists and philosophers to discuss the information problem in different fields of science. The discussion included not only aspects of formal information theory but also the general problem of exchange of information.

Participants came from Belgium, Czechoslovakia, France, Great Britain, the Netherlands, Poland, Switzerland, and the United States. The initial lecture given by L. Brillouin explores the processes by which the human mind establishes a law of science from experimental information. Other discussions of formal information theory as well as the general problems of exchange of information are included.

Analyses of both topics are made within the frameworks of logics, mathematics, physics, biology, and philosophy.

C. V. R.

Standard Methods in Clinical Chemistry (Vol. 5). Edited by Samuel Meites. (Academic Press, New York and London), 1965. Pp. xvii + 288. Price \$8.50.

Volume 5 of *Standard Methods of Clinical Chemistry* is an extension of the series initiated in 1953 by Dr. Miriam Reiner, and succeeded by three volumes under the guidance of Dr. David Seligson.

The contents of this volume are given below : Collection and Preservation of Specimens ; Sources of Error in Clinical Chemistry ; Principles of Automatic Chemical Analysis ; Blood Ammonia ; Bilirubin (Modified Jendrassik and Grof) ; Bilirubin (Modified Malloy and Evelyn) ; Recommendation on a Uniform Bilirubin Standard ; Total and Free Cholesterol ; Cholesterol (Primary Standard) ; Chloride in Sweat ; Ultramicro Glucose (Enzymatic) ; Lead in Blood and Urine ; Magnesium (Fluorometric) ; Magnesium (Titan Yellow) ; Methemoglobin ; Osmolality of Serum and Urine ; Phenylalanine ; Alkaline and Acid Phosphatase ; Total Proteins in Cerebrospinal Fluid (Colorimetric) ; Total Proteins in Cerebrospinal Fluid (Turbidimetric) ; Salicylate ; Urea Nitrogen and Urinary Ammonia ; Xylose.

C. V. R.

Ulotrichales. By K. R. Ramanathan. (Published by the Indian Council of Agricultural Research, Dr. Rajendra Prasad Road, Krishi Bhavan, New Delhi). Pp. 188. Price Rs. 21.50.

This is the sixth of a series of monographs on Algae being brought out by the ICAR. There has not been any recent systematic work of a review type on Ulotrichales ; the only comprehensive reference works on the subject are those of Hazen and of Heering published early in the century. Reference to later literature will bring out that frequent changes have taken place in the classification and delimitation of the various genera, families and suborders of the Ulotrichales within the framework of the class *Chlorophyceae*. These have been reviewed by the author in the Introductory chapter.

The author has taken pains to collect as much published information on the subject as possible

from original papers and well-known source books, and has presented a descriptive monograph with a large number of illustrations carefully reproduced to support the textual matter. About 20 genera comprising nearly 110 species belonging to seven families are described in the monograph.

As scientific publications will bear out, work in India on algae research is growing and in this context the present monograph on the Ulotrichales is sure to be accorded a warm welcome by students of algae as a guide-book on the subject.

A. S. G.

Books Received

Lignin Biochemistry. By W. J. Schubert (Academic Press, Berkeley Square, London W.1), 1965. Pp. ix + 131. Price \$8.00.

The Fungi An Advanced Treatise (Vol. I)—*The Fungal Cell.* By G. C. Ainsworth and A. S. Sussman. (Academic Press, New York), 1965. Pp. xvi + 748. Price \$24.00.

Advances in Astronomy and Astrophysics (Vol. 3). Edited by Zdenek Kopal. (Academic Press, New York), 1965. Pp. x + 391. Price \$14.00.

Handbook of Microwave Ferrite Materials. Edited by W. H. von Aulock. (Academic Press, New York), 1965. Pp. xxiv + 518. Price \$12.00.

Plasma Turbulence. By B. B. Kadomshev. (Academic Press Ltd., London W. 1). Pp. vii + 149. Price 40 sh.

Advances in Lipid Research (Vol. 3). Edited by R. Paoletti and D. Kritchevsky. (Academic Press, New York), 1965. Pp. xi + 263. Price \$23.00.

Sex Chromatin and Applied Cytogenetics. By J. D. S. Kumaran and S. J. Kumaran Jr. (S. Bhattacharya and Co., 49, Dharmatala St., Calcutta-13), 1965. Pp. vii + 165. Price Rs. 10.00.

Biogeography and Ecology in Antarctica. Edited by J. Van Mieghem and P. Van Oye (Dr. W. Junk, Publisher, The Hague), 1965. Pp. xxvii + 762. Price \$31.95.

Transistor Circuits (Second Edition). By K. W. Cattermole. (Baywood Pub. Co. Inc., New York and Gordon and Breach, 150, Fifth Avenue, New York 11, N.Y.), 1965. Pp. xiv + 470. Price \$14.50.

THE NEW PHYSIOLOGY OF VISION

Chapter XXXIX. Daltonian Colour Vision

SIR C. V. RAMAN

THE following questions arise regarding the abnormal colour perceptions exhibited by certain individuals. What exactly are the colours which they perceive and in what other respects do their visual perceptions differ from those of normal individuals? Further, what is the origin of these differences: in other words, what is the difference in the nature of the visual processes which is responsible for these abnormalities? Colour, though determined by the physical nature of the light which is perceived, is nevertheless a subjective phenomenon. This circumstance may make it difficult to ascertain what the actual facts are in any particular case. Complications would also arise, if the cases of defective colour vision met with are not all of the same kind, as is generally believed.

In earlier chapters, the subject of defective colour vision has been considered and it has already been shown that normal and abnormal colour vision can be brought into an intelligible relationship with each other. A few cases have also been considered in detail and it has been shown that they support the correctness of the approach made to the subject. Nevertheless, it was evident that further studies were necessary to obtain a fuller and deeper understanding of the facts observed. Hopes of further advance lay in the direction of applying new methods of investigation to the study of abnormal colour vision and of relating the results to those already established in the case of normal vision. While it was evidently desirable to extend the study to more cases, it was clear from the outset that it would be particularly useful to work with selected individuals exhibiting abnormal colour vision who by reason of their scientific training and experience could be relied upon to render trustworthy reports of their own personal observations in the contemplated studies.

In the present chapter, we shall set out the results which have emerged from an intensive study of abnormal colour vision made with the aid of an individual who will be referred to in what follows as Dhruva, which, of course, is not his real name. Dhruva is a highly qualified physicist. That his colour vision was abnormal was discovered in the course of surveys

undertaken by the author to find such cases. His scientific competence and his enthusiastic co-operation in the investigation has made a real advance possible in our knowledge and understanding of the subject of abnormal colour vision and of its relationship to normal vision.

The Colour Sequence in the Spectrum.—It is a remarkable fact that a person endowed with normal vision is capable of recognising quite small differences in colour if these are presented to him in an appropriate fashion. For example, the two yellow lines in the spectrum of a mercury lamp whose wavelengths are respectively 5770 Å and 5790 Å and which are of equal intensity when seen simultaneously through the eye-piece of a spectrometer exhibit an observable difference in colour, the former line appearing of a greenish hue while the latter is a pure yellow. This fact suggested to the author that an arrangement by which the entire continuous spectrum is presented as a series of discrete lines but without any change in the relative intensities of its different parts would be a useful device for the study of the spectrum colours and especially for exhibiting the differences in the rate of progression of colour in different parts of the spectrum.

The idea indicated above can be realised in practice by setting two half-silvered plates of glass in parallel positions before the slit of a wavelength spectrometer and viewing the spectrum of a brilliant source of white light of restricted area normally through the combination. The entire spectrum is then seen as an array of discrete lines or bands in a dark field, their number and spacing being determined by the separation between the plates. By making one of the plates movable with respect to the other, the number of lines or bands seen in the spectrum can be varied within wide limits. The more numerous they are, the smaller would be the difference in wavelengths between adjacent ones. If such difference is large enough, they would exhibit an observable difference in colour. But this would not be the case, if the bands are numerous and therefore closely spaced. Much would depend on the particular part of the spectrum and the rate at which the progression of colour is manifested therein.

A channelled spectrum with approximately 100 bands in it produced in the manner explained was presented to Dhruva. He examined it through the eye-piece of a wavelength spectrometer and listed the parts of the spectrum which appeared to him to be different in colour and their respective wavelength limits. His findings are exhibited on the right-hand side of Fig. 1, while those of an observer with normal colour vision made under exactly the same conditions are shown on the left-hand side of the figure.

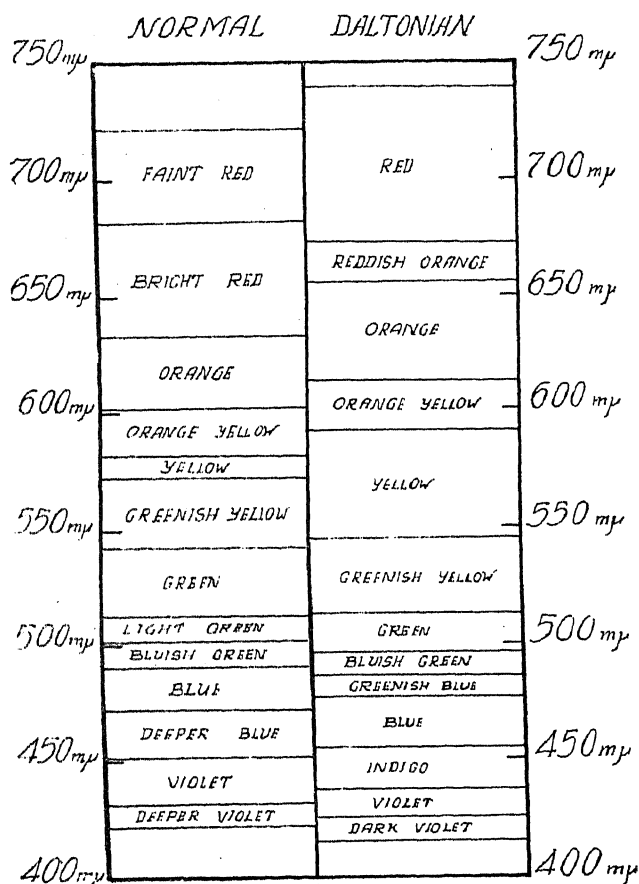


FIG. 1. Colour Sequence in the Spectrum.

A comparative study of the two sides of Fig. 1 is very instructive. To a normal observer, the yellow of the spectrum appears as a narrow strip in the wavelength range from 575 mμ to 585 mμ. But, to Dhruva under the particular conditions of observation, it appears as a wide tract of the spectrum and the regions in which a normal observer perceives the colours of red and green have for the most part also been

replaced by colours related to or resembling yellow. It is clear from the diagram that Dhruva's vision is Daltonian. It would nevertheless not be correct to say that he is either red-blind or green-blind or both red-blind and green-blind. A correct description of what is actually observed is that the sensation of yellow perceived by him has extended itself so as to cover a large part of the spectrum and modify the colours seen by a normal observer in adjoining areas. In this context, it is noteworthy that to Dhruva, the part of the spectrum which appeared to be the most luminous is that in which a normal observer locates the yellow strip.

Effect of Luminosity on the Spectrum Colours.

—A remarkable and convincing demonstration that Daltonian vision arises by reason of an abnormal enhancement of the sensation of yellow in relation to other colours in the spectrum is forthcoming from the observations of Dhruva on the emission spectrum of a heated tungsten filament over a wide range of temperatures. The filament is a straight long coil of fine wire and is heated by the passage of an electric current through it. This current could be controlled by a rheostat, and the temperature of the filament could therefore be stepped up over a great range, beginning with its emission barely visible as a dull red glow and going up to one at which the filament emits a brilliant white light. The spectrum of the emission can be examined very simply by viewing the luminous filament from an appropriate distance through a replica diffraction grating held in front of the observer's eye. As the temperature is raised, a whole series of changes manifests itself in the colours visible in the diffraction spectrum of the first order. The observations are made in a completely darkened room, a dark background being provided so that the spectrum could be viewed against it. The observations of Dhruva are reproduced below exactly as recorded by him at the time.

1. *Extremely Low Levels.*—At these faint and barely perceptible levels, only the green portion of the spectrum is visible.
2. At slightly higher levels, the red region faintly makes its appearance, though the green is brighter. The relative lengths of the regions are : Green (1); Red (0.5).
3. At still higher levels, the intensity maximum shifts to the red region, and at the stage when the maximum is definitely at the red, the relative lengths are : Green (1); Red (1).

4. The next stage is reached when the yellow distinctly appears. Simultaneously the maximum intensity region moves over to orange-yellow. The blue also makes its appearance about this stage. Relative lengths are: Blue (1); Green (1.5); Yellow (1); Red *plus* Orange (1.5).
5. At higher luminosity, the yellow invades the red and assumes the position of maximum luminosity. At this stage, the relative lengths are: Blue (1.5); Green (1); Yellow (2) Red *plus* Orange (2).
6. This trend is continued at higher levels, the yellow becoming most intense and invading the red and the green. The relative lengths of the colour regions at this brightest stage are: Blue (2); Green (0.5); Yellow (4); Red (1).

An observer with normal colour vision observing the spectrum of the glowing tungsten filament under exactly the same conditions as in the observations by Dhruva also notices changes in the character of the spectrum of the emitted light, including especially the manifestation and progressive increase in luminosity of the yellow sector. But there is a great difference between Dhruva's observations and those of the normal individual. The development of the yellow sector, and its invasion of the green and red sectors are far more striking in Daltonian vision than for a normal observer. The normal observer does not observe the contraction of the green and red sectors conspicuously evident in Daltonian vision.

The yellow of the spectrum is the major visual sensation to an observer with normal colour vision at ordinary or daylight levels of illumination. It is totally absent in night-vision; *per contra*, at extremely high levels of brightness, as has been described in an earlier chapter, the yellow sensation becomes the dominant sensation to an extraordinary extent, reducing the rest of the spectrum to a relatively insignificant position. In other words, the characteristics of Daltonian vision resemble those exhibited by normal colour vision at exceptionally high luminous intensities. The abnormality which is responsible for their manifestation is thus connected with the visual mechanism which determines the strength of the yellow sensation at various levels of brightness.

The Perception of Red.—It will be noticed from Fig. 1 that the part of the spectrum described as red by Dhruva is of very low luminosity to a normal observer, while the part which is bright red to a normal observer appears as orange to Dhruva. It follows that while it would be entirely incorrect to describe Dhruva as red-blind, nevertheless his perceptions of red would be much weaker than those of normal individuals. This is borne out by the studies made of the characteristics of his vision. When the colour test-charts published by the American Optical Society were shown to him, he was unable to recognise the numeral 9 very clearly exhibited as a sequence of spots of a red colour surrounded by other spots of similar shapes of which some were grey and the others black. Likewise, in these charts, he was unable to recognise numerals printed as dots in various shades and depths of a red hue in a field surrounded by dots printed in various shades and depths of green and greenish-yellow. He was also unable to recognise numerals printed in dots of pale red colour in a field of dots exhibiting various shades of pale yellow and brown.

The colour vision of Dhruva was also tested by showing numerous hard-cover books which he had not seen previously and asking him to name their colours. Amongst them were several exhibiting hues ranging from a brilliant red to a dark brown tinged with red. In several cases, he named as red, books of which the cover was more nearly brown than red. From these and other instances, it was evident that his perceptions of red differed rather widely from those of normal individuals. Similar differences become evident when he was presented with a set of samples of dyed silk fabrics and asked to classify them and to name their colours.

Perception of Green.—It is evident from Fig. 1 that the sharp distinction between green and yellow manifested in the colour vision of normal individuals does not exist for Dhruva. Indeed, the yellow lines at $579\text{ m}\mu$ and the green line at $546\text{ m}\mu$ of the mercury lamp did not appear to him to be distinguishable in colour. Figure 1 indicates that Dhruva perceives as green in colour a part of the spectrum adjoining the blue at about $500\text{ m}\mu$. Presumably therefore in certain cases, he should be capable of recognising as different from each other in colour the objects which are named respectively as green, yellow and red by normal observers.

Presented with several books bound in hard-covers of various colours, Dhruva in most cases

named as green or dark green the books which would be described in the same manner by normal observers. There were however a few cases in which his naming of colours differed quite sharply from the usual ones. A book with an orange-yellow cover was named as green, and another as ash-grey which was a light greenish-blue. A third book which was a pale yellow was named as a greenish-yellow. In his naming of the colours of a series of dyed silks, it was evident that Dhruva found it difficult to distinguish pure greens from bluish-greens and likewise to distinguish blues from bluish-green colours.

In the tests made with the colour charts of the American Optical Company, Dhruva read without error or hesitation the numerals in the charts in which they were printed as dots in greenish colours surrounded by a field of dots printed in colours ranging from yellow to orange. Likewise, he could read without error or hesitation numerals printed as dots ranging in colour from pale yellow to orange surrounded by a field of dots printed in colours of various shades of green.

The Purple Sensation.—The studies of composite colours described in earlier chapters made it evident that a purple sensation results when the yellow sector is eliminated from the spectrum of white light while the blue, green and red sectors are left without change. Any alteration in the relative strength of the red sector as compared with the strength of the blue and green sector taken together results in different shades of purple. The weakening of the red sector results in the purple assuming bluer shades, while any weakening of the blue or green sectors results in the purple exhibiting hues more nearly akin to red.

In view of the foregoing remarks, it is significant that when Dhruva was shown the flowers of the ground orchid "*Spathoglottis plicata*" he named their colour as blue, whereas to a normal observer they exhibit a reddish-purple colour. Spectroscopic examination reveals three well-defined absorption bands in the light transmitted through or reflected by the petals of the flower. The principal band extinguishes the yellow sector, while the two other weaker bands appear respectively in the green and in the greenish-blue, thus accounting for the reddish-purple colour of the flower. That Dhruva perceives the flowers as blue in colour is a demonstration that his perception of red is very weak.

Bougainvillia with its clusters of brilliantly-coloured bracts is one of the best-known and most highly favoured of ornamental plants. Several varieties of it are known with bracts exhibiting purple hues. Bracts of three such varieties were shown to Dhruva. He named all of them as blue flowers, qualified by the remark in brackets (tinge of violet) in the case of the deepest purple, and (light) in the case of the palest purple.

The Colours of Interference.—Dhruva was shown three items of apparatus exhibiting interference colours brilliantly on a large scale. The following is a description in his own words of the region surrounding the central dark spot in the pattern exhibiting Newton's Rings. First ring—Reddish inside grading over to darkness; this is followed by a brighter region where the colours change radially blue to yellow before the next dark ring is reached. There is a further bright zone where the colours change from blue to yellow; the next dark ring is fainter, i.e., contrast is less. As we move across radially, further rings appear, but it occurs to me as if the bluish tinge is less and less and the contrast drops very sharply—rings beyond the fifth or sixth being barely visible. Up to the fourth ring, the yellow looks prominent in the bright region, beyond which it is a uniform grey (except for alternation of intensities due to the rings).

Interference Fringes of Wedge-Shaped Film.—These are described by Dhruva as follows: Starting from the top of the plate, the first dark band is bordered by red and orange at the top and blue at the bottom. This is followed (proceeding downwards) by orange, black (i.e., the dark band) and blue for the second band. The third band is bordered by orange-red at the top but the blue is much fainter. Three more bands are visible, but with decreasing contrast. The colour variations for these are not visible—they can only be described as shades of grey.

The Interference Fringes in a Pattern of Ovals.—The outermost dark oval ring is followed by patches of blue and orange red, to the second (inner) dark ring. The transition to the third ring is similar, but the bluish tinge is much weaker here. The fourth and innermost ring is much fainter in contrast and appears as a dull brownish-red. The patch inside this ring has the same contour, and shows up as a dull grey contrast to the background.

GEOPHYSICAL STUDIES OF THE RAMNAD BASIN, MADRAS STATE*

L. N. KAILASAM

Geological Survey of India

THE results of gravity, magnetic and seismic investigations conducted by the Geological Survey of India in the coastal sedimentary areas of Madras State have been presented in previous papers by the author (1958, 1961, 1963, 1964). These surveys, besides establishing a substantial thickness of 8,000 to 10,000 feet of sediments along the seacoast in the South Arcot and Tanjore Districts, have also brought out some prominent structural features associated with the pre-Cambrian basement in the Porto Novo, Karaikal and Tiruthuraipundi areas, and these appear to be significant and important in respect of their petroleum possibilities. The Karaikal structure is associated with a prominent basement high and partly extends into the sea in the off-shore areas, with a thickness of sediments of the order of 5,500 to 6,000 feet over the crest of the structure as estimated from reflection seismic data (Kailasam, 1961, 1962). Test drilling is now being carried on by the Oil and Natural Gas Commission over this structure and it is reported that the first test well drilled over the crest of the structure struck basement rocks at a depth of roughly 1,750 metres in remarkable agreement with the seismically estimated depth. Some oil shows have also been reported from this test well. Further to the north and south along the seacoast over the flanks of this feature, a thickness of the order of 9,000 feet of sediments has been indicated by the seismic data.

The geophysical data further suggest that the sedimentary areas in the Madras coast may be considered to consist broadly of three major basins (Fig. 1), separated by buried ridges of the pre-Cambrian crystallines branching out towards the sea from the main crystalline mass of the peninsula in a roughly north-east direction. The first of these basins, most parts of which fall within the South Arcot District and which is therefore designated as the South Arcot Basin, is bounded on the south by a buried ridge disposed roughly along the Coleroon river. To the south of this basin lies the Tanjore or Cauvery Basin (basin 2). The southern margin of the Tanjore Basin is characterised by another ridge of the crystallines branching off from the

peninsular mass near Manamadurai, passing south of Sivaganga and extending to the north-east through Kalaiyarkoil and Devakottai to Kattumavadi on the Palk Strait (Fig. 1). To the south of this buried ridge lies a third shallower basin in the Ramanathapuram (Ramnad) District and which is designated as the Ramnad Basin.

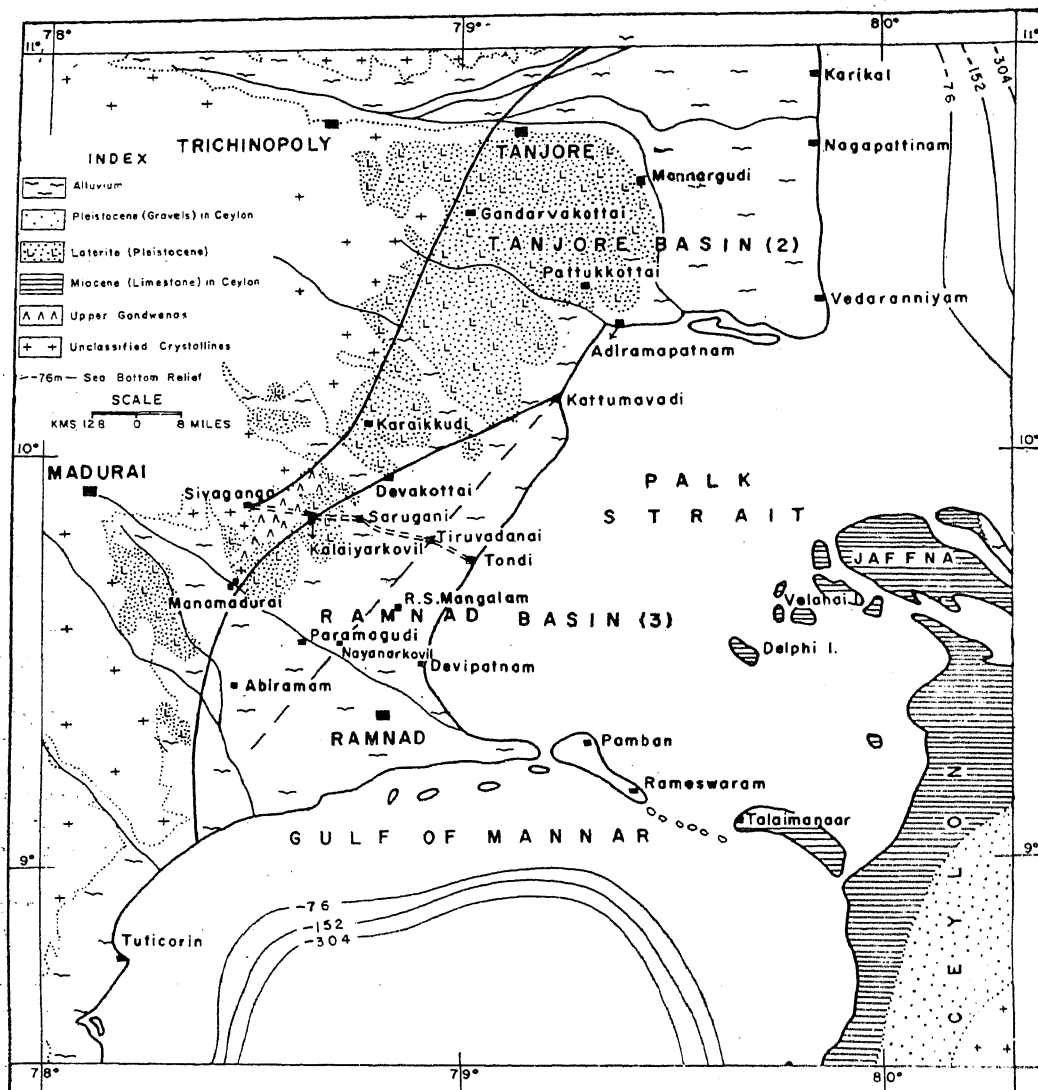
Details in respect of sedimentary thickness, basement configuration and structural features of the South Arcot and Tanjore Basins have been presented in the previous papers referred to. The main features of the Ramnad Basin as deduced from the geophysical data are presented in this paper.

The Archæan formations which occur mostly in the western and north-western parts include hornblende gneiss, calc granulites, charnockites and quartzites with a general ENE-WSW strike. The Archæans are overlain unconformably by the Upper Gondwana rocks (middle to late Jurassic in age), fluvatile in origin and consisting of boulder beds, conglomerates and hard micaceous sandstones with alternating shales and grits. These are best exposed in the Sivaganga area (Fig. 1). The tertiary formations (Mio-Pliocene) which consist of coarse sandstones, grits, clays and conglomerates are seen near Karaikudi, Pallattur, Ariyakudi, Sakottai and a few other places. They are the same as the Cuddalore formations encountered further to the north in the Madras coast. The tertiary rocks in the Ramanathapuram District are mostly covered by a cap of hard laterite (Pleistocene) varying in thickness from 6 to 12 feet in the Sivaganga area to a thickness of 10 to 20 feet in the Karaikudi and Pallattur areas.

Outcrops of the Cretaceous rocks are not seen in the Ramnad District in contrast with their occurrence in the South Arcot and Tanjore Basins to the north. A major part of the sedimentary area in the Ramnad District is covered by alluvium (Fig. 1).

Reflection and refraction seismic investigations for ground water carried out recently in the Ramanathapuram District by the Geological Survey of India have brought out some interesting subsurface features. To the south-east of Kunnakudi which is on the gneisses and some four miles to the north-west of Karaikudi (Fig. 1),

* Published with the kind permission of the Director-General, Geological Survey of India.



the seismic data indicate a sudden deepening of the basement to more than 5,000 feet. Further to the south-east of Karaikudi and some four miles to the north-west of Devakottai, the basement again rises abruptly, its depth in the Devakottai area being of the order of 300 feet. This area which is the south-western tapering end of the Tanjore Basin 2 is thus characterised by marked faulting.

Mathew and Jagannadham (1962, 1964) under the direction of the author is shown in Fig. 2. Between Sivaganga and Nattarasankottai the refraction seismic data indicate prominent faulting in the basement, which is apparently the south-western extension of the faults indicated to the north-west and south-east of Karaikudi referred to earlier, giving rise to a graben-like feature in this region. The Upper Gondwana rocks are exposed in this area, as can be seen from the geologic section. The basement is quite shallow in the Nattarasankottai area, being of the order of 100 feet. Between Nattarasankottai and Kalaiyarkoil, a

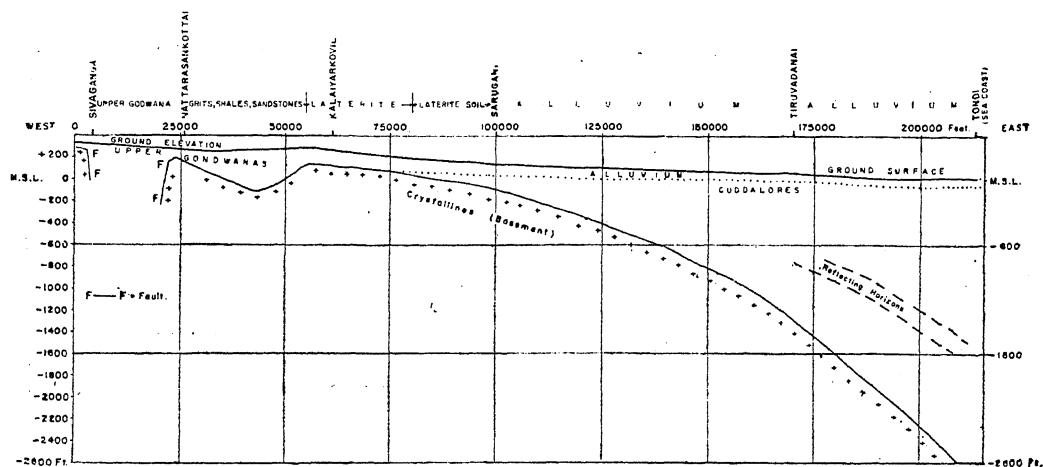


FIG. 2

local depression in the shallow basement is indicated, overlain by the Upper Gondwana rocks. In the Kalaiyarkoil area, the basement is indicated at a depth of the order of 100 to 150 feet and is apparently overlain by weathered gneisses and alluvium as can be seen from well cuttings. Further to the east of Kalaiyarkoil, the basement slopes down gently up to Sarugani where its depth is indicated to be of the order of 200 to 250 feet. To the east of Sarugani, the basement deepens rather steeply, and this trend continues all the way to Tondi on the coast, the basement depth at Tiruvadanai and Tondi being roughly 1,500 and 3,000 feet respectively. Also, to the east of Sarugani, beneath the thin alluvial cover, a seismic layer of velocity of 7,000 to 8,000 feet per second is indicated, which may be representative of Cuddalore formations. Between Tiruvadanai and Tondi the reflection seismograms also bring out a few well-defined reflections from the deeper horizons (Fig. 2). In this connection it will be relevant to refer to the borehole data pertaining to the exploratory tube-wells for ground water sunk in the Ramnad District in the past few years by the Exploratory Tube-Well Organisation of the Government of India in collaboration with the Geological Survey of India. The deepest of these wells in this region drilled at Tiruvadanai and taken to a depth of 1,021 feet without touching basement has indicated beneath the alluvium Cuddalore strata consisting of clays, sands, etc., up to a depth of 295 feet from the ground level, below which calcareous clays and fossiliferous sandstones are reported to have been encountered. It is,

therefore, likely that the 295 feet level at Tiruvadanai represents the base of the Cuddalore's below which the formations probably belong to the Eocene sequence as at Alappakkam near the seacoast to the south-west of Cuddalore in South Arcot District where Eocene rocks are known to underlie the Cuddalore formations at a depth of roughly 630 feet, as proved by a borehole drilled for water. In the borehole at Tondi taken to a depth of 600 feet, fossiliferous, calcareous sandstones were encountered at a depth of 333 feet from ground level, which may represent the base of the Cuddalore's.

At Kattumavadi on the shores of the Palk Strait (Fig. 1), reflection shooting has indicated a basement depth of the order of 1,500 feet. The basement progressively deepens southward along the coast and its depth at Tondi, as already stated, is of the order of 3,000 feet.

In the Paramagudi area further to the south-west in this basin, the basement is indicated at the same shallow depths as at Sarugani, being of the order of 250 to 300 feet. Thus, roughly to the west of a line joining Kattumavadi, Tiruvadanai and Nayanarkovil just to the east of Paramagudi (Fig. 1), the basement lies at shallow depths of less than 1,500 feet, with larger depths to the east of this line (dashed line in Fig. 1). Further to the south-east towards the Palk Strait, the seismic data indicate a sudden deepening of the basement. Reflection shooting at a point 6 miles to the north-east of Ramnad town on the Ramnad-Devipatnam Road indicates a basement depth of roughly 6,000 feet. The seismogram for this seismic shot on the Ramnad-Devipatnam Road is reproduced in

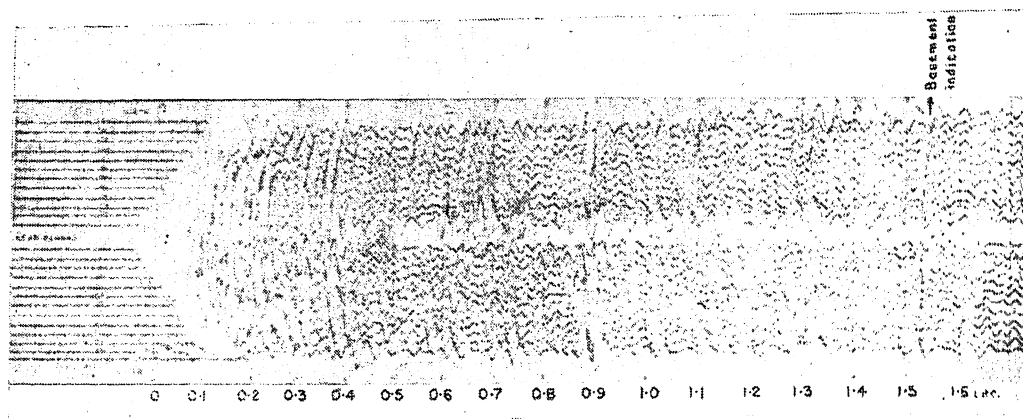
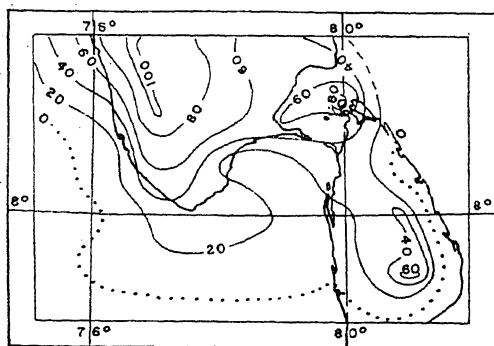


FIG. 3

Fig. 3 and brings out the basement indication clearly. Thus, over a small emerged part of the Ramnad Basin including Devipatnam and Ramnad, the sedimentary thickness is more than 6,000 feet. The basement is seen to deepen further in a south-east direction from the Ramnad coast into the Palk Strait which is a shallow sea. The eastern margin of the Ramnad Basin is represented by the sedimentary tracts of the north-western coast of Ceylon and the Jaffna Peninsula which are occupied by Miocene formations consisting mainly of fossiliferous limestones (Fig. 1).

The southern limits of the Ramnad Basin are defined by the northern margins of the Gulf of Mannar. The broad, generalised Bouguer gravity map of these parts as presented by Gulatee (1956) is shown in Fig. 4. This map



BOUGUER GRAVITY ANOMALIES
After Gulatee, 1956

—20— BOUGUER GRAVITY ANOMALIES IN MILLIGALS

FIG. 4

shows a prominent gravity low in the form of a nose extending from the south-eastern coast of the peninsula into Ceylon through its north-western parts trending in a north-west-south-east direction. The same map also shows a local gravity low near the Jaffna coast of Ceylon.

As has been stated, the seismic data clearly indicate a fairly large thickness of more than 6,000 feet of sediments in the off-shore areas of the Ramnad coast in the south-eastern parts of the Palk Strait. It is quite likely that similar large thickness of sediments also occurs in the fringes of the north-western coast of Ceylon, especially the Jaffna coast, as also in the off-shore areas in its western neighbourhood including the Velahai and Delphi islands where reflection seismic shooting should yield valuable and interesting results.

The results described herein and the foregoing discussions clearly indicate the scope for further detailed geophysical surveys in the Ramnad Basin of which the Palk Strait constitutes the major part, and the off-shore areas of the Ramnad coast and the north-western coast of Ceylon should be considered important in respect of their petroleum possibilities.

1. Kailasam, L. N., "Geophysical exploration in the coastal sedimentary belt of Madras State," *Curr. Sci.* 1958, **27**, 476.
2. Gulatee, B. L., "Gravity data in India," *Survey of India Technical Paper No. 10*, 1956.
3. Kailasam, L. N., "Seismic exploration in the Karaikal-Nagore area of the Cauvery Basin, Madras State," *Curr. Sci.*, 1961, **30**, 168.
4. Krishnan, M. S., *Geology of India and Burma*, 1961.
5. Kailasam, L. N. and Simha, K. R. M., "A Reflection Seismic traverse across the coastal sedimentary belt of South Arcot District, Madras State," *Bulletin of the National Geophysical Research Institute, CSIR*, 1963, **1**(3), 151.
6. —, "On the structure of the sedimentary basins of the coastal areas of Madras State," *Indian Geophysical Union Bulletin No. 1*, 1964, p. 103.
7. Mathew, P. M., Unpublished Report of the Geological Survey of India, 1962, on the geophysical investigations for ground water in the Ramanathapuram District, Madras.
8. Jagannadham, M., Nayak, P. M. and Joga Rao, M. V., Unpublished Report of the Geological Survey of India, 1964, on the geophysical studies for ground water in parts of Ramanathapuram District, Madras.

LETTERS TO THE EDITOR

DIELECTRIC PROPERTIES OF
AQUEOUS SOLUTIONS OF CERTAIN
SALTS OF TRANSITION GROUP
ELEMENTS

ALTHOUGH a large amount of experimental work has been done in studying the dielectric constants, loss factors and relaxation times of electrolytic solutions and variation of these properties with concentration, the work is mostly confined to salts of the first, second and third group elements. In order to extend the available experimental data, the dielectric properties of aqueous solutions of the chlorides and sulphates of certain transition group elements have been measured.

The method of measurement is similar to the one used by Harries and O'Konski.¹ The power source is a 723 A/B klystron modulated at 30 cycles per second. Measurements of dielectric constant ϵ' and loss factor ϵ'' were made at wavelength of 3.14 cm. for a range of concentrations extending upwards from 0.25 M. Conductivities of the same solutions were measured at 1,000 cycles per second and a correction for conductivity loss was applied to the observed loss factors by means of the equation

$$\epsilon''_{\text{dipolar}} = \epsilon''_{\text{total}} - \frac{2\sigma}{f}$$

where σ is the specific conductivity in electrostatic units and f is the frequency. Taking the value of the high frequency dielectric constant ϵ_{∞} of the solution as identical with the value for pure water ($=5.5$), the static dielectric constant ϵ_s and relaxation wavelength λ_s were calculated for each concentration. The values obtained for ϵ' , ϵ'' and λ_s for the different salts are listed in Table I.

An examination of the results shows that for all the sulphates, the variation of ϵ_s with concentration is linear up to a concentration of 1 M. In the case of the chlorides, however, the variation becomes non-linear even at much lower concentrations.

The authors express their grateful thanks to Prof. K. R. Rao for his interest in the work. One of them (P. S. K. M.) is grateful to the Council of Scientific and Industrial Research for the award of a research fellowship.

TABLE I
Dielectric constant data at $T = 28^\circ \text{C}$.

Solute	Con- centration Moles/ litre	ϵ'	ϵ'' dipolar	ϵ_s	λ_s in cm.
$\text{MnCl}_2 \cdot 4\text{H}_2\text{O}$	0.25	60.0	21.9	68.8	1.26
	0.50	57.8	15.3	62.3	0.92
	0.75	57.0	12.8	60.2	0.78
	1	55.6	9.9	57.5	0.62
	2	54.0	5.0	54.5	0.32
$\text{MnSO}_4 \cdot 4\text{H}_2\text{O}$	0.25	58.5	19.3	65.5	1.14
	0.50	57.0	18.0	63.0	1.07
	0.75	55.3	14.8	59.7	0.94
	1	53.5	13.1	57.1	0.86
	2	48.5	12.9	52.4	0.94
$\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$	0.25	58.3	22.4	67.8	1.33
	0.50	56.3	17.8	62.6	1.10
	0.75	54.6	15.1	59.3	0.96
	1	53.8	12.7	57.1	0.82
	2	52.0	7.7	53.2	0.52
$\text{CoSO}_4 \cdot 7\text{H}_2\text{O}$	0.25	59.8	21.0	67.9	1.21
	0.50	57.8	19.1	64.8	1.15
	0.75	56.4	16.6	61.8	1.03
	1	54.9	15.9	60.0	1.01
$\text{NiCl}_2 \cdot 6\text{H}_2\text{O}$	0.25	61.5	20.7	69.1	1.31
	0.50	57.8	12.1	59.4	0.72
	0.75	56.0	9.2	58.6	0.56
	1	54.7	7.1	55.3	0.45
	2	52.8	5.2	53.4	0.34
$\text{NiSO}_4 \cdot 6\text{H}_2\text{O}$	0.25	60.4	18.5	66.6	1.05
	0.50	57.7	16.3	62.8	0.98
	0.75	56.9	14.4	60.9	0.88
	1	55.8	13.3	59.3	0.83
	2	54.4	9.2	56.1	0.59
$\text{CuCl}_2 \cdot 2\text{H}_2\text{O}$	0.25	60.5	18.4	66.7	1.05
	0.50	58.1	12.6	61.1	0.75
	0.75	57.3	9.7	59.1	0.59
	1	56.7	7.3	57.7	0.45
	2	54.2	3.6	54.4	0.23
	3	52.7	4.9	53.2	0.33
$\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$	0.25	60.1	19.3	66.9	1.11
	0.50	59.2	16.9	64.5	0.99
	0.75	58.1	14.5	62.1	0.87

Microwave Lab., P. S. KRISHNA MOHANA RAO.
Physics Dept., D. PREMA SWARUP.
Andhra University,
Waltair, January 29, 1966.

1. Harries, F. E. and O'Konski, T., *The Review of Scientific Instruments*, 1955, **26** (5), 482.

POLAROGRAPHIC REDUCTION OF COPPER RESACETOPHENONEOXIME

EXTENSIVE studies have been made on the polarographic reduction of metal complexes in aqueous-non-aqueous solvent mixtures. Dielectric constant was found to have a pronounced effect on the stability of the complex as evidenced by a change in half-wave potential with change in solvent composition. Copper formed with resacetophenoneoxime an insoluble brown 1:2 complex.¹ The complex was found to be soluble in aqueous 2-ethoxy ethanol containing more than 55% of the non-aqueous solvent by volume. The present investigation deals with the polarographic reduction of simple cupric ion and copper resacetophenoneoxime in aqueous 2-ethoxy ethanol solutions of different compositions at a constant ionic strength (0.1). The investigation was undertaken to study the effect of solvent composition on the stability of the complex and the simple cupric ion.

Resacetophenoneoxime was prepared by the procedure mentioned in a previous paper.² The precipitation of the complex was carried out at laboratory temperature by adding 50% aqueous alcoholic solution of resacetophenoneoxime with stirring to copper sulphate solution acidified with acetic acid. The complex was filtered, washed with hot water, and dried at 100°C. A stock solution (0.01M) was prepared by dissolving 100 mg. of the complex in 25 ml. of 2-ethoxy ethanol. 2-ethoxy ethanol, E. Merck sample was used as solvent. The purity was ascertained from the absence of polarographic wave in the voltage range of study. Tween-80 supplied by Light & Co., Colonbrook, England, was used as maximum suppressor as gelatin was found unsatisfactory. Dr. Lange's Polarometer model 3, coupled with multiflex galvanometer, was used.

Two ml. of the stock solution of the complex (0.01M), 2 ml. of potassium nitrate solution (1M) were mixed with requisite volumes of 2-ethoxy ethanol and distilled water to obtain the required percentage of non-aqueous component by volume. The total volume of the solution was kept at 20 ml. A drop of Tween-80 was added to suppress the maximum. The solution was deaerated by bubbling pure hydrogen gas for 30 minutes and the polarograms were obtained. In the case of simple cupric ion, the complex solution was replaced by 2 ml. of aqueous copper sulphate solution (0.01M) and correspondingly the volume of the non-aqueous component was changed to get the required percentage.

TABLE I

% of 2-ethoxy ethanol by volume	Half-wave potential ($E_{1/2}$)* vs. S.C.E. (volts)		$E_{1/2c} - E_{1/2s}$ (volts)
	Simple Cu^{++}	Copper complex	
55	+0.02	-0.64	0.66
60	+0.02	-0.66	0.68
71	+0.03	-0.73	0.76
80	+0.04	-0.77	0.81

* No correction was made for liquid junction potential.
c=complex; s=simple.

The above results indicate that the half-wave potential of the complex is more negative in higher percentage of the non-aqueous solvent. It can be said that the stability of the complex increases with increase in percentage of the non-aqueous solvent, i.e., with decrease of dielectric constant of the medium.

Department of Chemistry, V. SESHAGIRI.
Sri Venkateswara Univ. S. BRAHMAJI RAO.
College, Tirupati (South India),
December 23, 1965.

1. Raju, N. A. and Neelakantam, K., *Curr. Sci.*, 1950, 19, 383.
2. Seshagiri, V., Krishna Reddy, Y. and Brahmaji Rao, S., *Proc. Ind. Acad. Sci.*, 1965, 62, 231.

ABSORPTION SPECTRA OF INORGANIC CO-ORDINATION COMPLEXES

Octahedral Complexes of Nickel (II) Borate with Uni- and Bidentate Aliphatic Amines

FORMATION of co-ordination compounds between Nickel (II) borate and ammonia has been reported.¹ No detailed work on the subject has so far been done.

Co-ordination complexes between Nickel (II) borate, ammonia, ethylenediamine and propylenediamine have been prepared. The general molecular formulæ on the basis of percentages of constituent elements turn out to be $[\text{Ni}(\text{am})_6](\text{BO}_2)_2$ and $[\text{Ni}(\text{am})_3](\text{BO}_2)_2$. The visible absorption measurements show a number of bands in the vicinity of 925 $\text{m}\mu$ (10800 cm^{-1}), 560 $\text{m}\mu$ (18000 cm^{-1}) and 360 $\text{m}\mu$ (28600 cm^{-1}) corresponding to the various permitted $d_{\gamma}-d_e$ transitions.

The following general method has been used for the preparation of the complexes.

500 mg. of powdered nickel (II) borate was suspended in 10 c.c. of acetone. A little more than the calculated quantity of amine was added. The reaction mixture was shaken for

5 days. The resulting complex was filtered, washed several times with acetone and dried over P_4O_{10} .

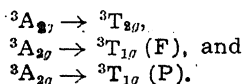
(1) *Hexa (ammino) Nickel (II) Borate*.—The complex is blue in colour and soluble in formamide. Found Ni = 23.66%, N = 33.89%, NH_3 = 41.63%, visible absorption bands = 925 $m\mu$, 570 $m\mu$ and 360 $m\mu$, $H_{18}N_6B_2O_4 \cdot Ni$ requires Ni = 23.83%, N = 34.11%, NH_3 = 41.42%.

(2) *Tris (Ethylenediamino) Nickel (II) Borate*.—The complex is light brown in colour, soluble in formamide. Found Ni = 18.23%, N = 25.6%, $H_2N \cdot CH_2CH_2NH_2$ = 55.23%, bands = 930 $m\mu$, 555 $m\mu$ and 355 $m\mu$; $C_6H_{24}N_6B_2O_4 \cdot Ni$ requires Ni = 18.10%, N = 25.9%, $H_2NCH_2CH_2NH_2$ = 55.51%.

(3) *Tris (Propylenediamino) Nickel (II) Borate*.—The complex is light brown in colour, soluble in formamide. Found Ni = 16.22%, N = 22.63%, $H_2NCH_2CH_2CH_2NH_2$ = 60.18%, bands = 915 $m\mu$, 560 $m\mu$ and 360 $m\mu$; $C_9H_{30}N_6B_2O_4 \cdot Ni$ requires Ni = 16.02%, N = 22.93%, $H_2NCH_2CH_2CH_2NH_2$ = 60.6%.

The bases were estimated as outlined by Shukla and others.² The visible absorption measurements were done in formamide, on a unicam S.P. 500 spectrophotometer.

The ground state of nickel (II) in octahedral co-ordination is $^3A_{2g}(t_{2g})^6(e_g)^2$; it is seen from energy level diagram that Ni(II) in octahedral co-ordination will always possess two unpaired spins. Three absorption bands corresponding to the following transitions should then be observed.³⁻⁵



In addition, some spin forbidden triplet to singlet bands could appear. Jorgensen^{6,7} found for pale green $[Ni(H_2O)_6]^{+2}$ the three bands at 8500 cm^{-1} , 13500 cm^{-1} and 25300 cm^{-1} , respectively, and for the violet $[Ni(NH_3)_6]^{+2}$ at 10700 cm^{-1} , 17500 cm^{-1} and 28200 cm^{-1} .

The observed spectra of octahedral Ni(II) complexes (listed above) have indeed confirmed the above features. The complexes have violet colour in formamide in contrast to the bright green colour of the hexa-aquo nickel (II) ion. This is because of shifts in the absorption bands when H_2O ligands are replaced by others lying toward the stronger end of the spectrochemical series.

The author wishes to acknowledge his indebtedness to Professor S. N. Shukla for providing facilities for this work.

Department of Chemistry, GOPAL NARAIN,
Lucknow University,
Lucknow (India), November 25, 1965.

1. Krymova, L., *Latoijas PSR Zinatnu Akad. Vestis.*, 1956, No. 4, 139.
2. Padmaja Shukla, Khare, M. P. and Srivastava, L. N., *Z. anorg. allg. chemie.*, 1964, 333, 167.
3. Orgel, L. E., *J. Chem. Phys.*, 1955, 23, 1004.
4. Tanabe, Y. and Sugano, S., *J. Phys. Soc. Japan*, 1954, 9, 766.
5. Ballhausen, C. J., *Kgl. Danske videnskab. Selskab. Mat. fys. Medd.*, 1955, 29 (8).
6. Jorgensen, C. K., *Acta Chem. Scand.*, 1955, 9, 1362.
7. —, *Ibid.*, 1956, 10, 887.

DIBROMO TETRAKIS-THIOUREA MANGANESE (II) COMPLEX

DIVALENT manganese ion has an effective $3d^5$ electronic configuration and hence represents a spherically symmetrical non-bonding shell. As such it causes least perturbation to the preferred stereochemistry—either octahedral or tetrahedral, the non-bonding shell being $d_{xy}^2 d_{xz}^3$ or $d_{yz}^2 d_{xz}^3$ respectively. Many spin-free hexa-co-ordinated complexes of divalent manganese have been reported¹ in a review by Goldenburg. A thiourea complex of manganese chloride was first reported by Rosenheim and Meyer² in 1906 and it was again prepared and characterised³ as a spin-free, octahedral complex. Attempts are now made to prepare analogous bromo-, iodo- and thiocyanato complexes.

Manganous bromide and thiourea were mixed in stoichiometric ratio (1:4) in ethanol and refluxed for 2 hours. The resulting solution was concentrated and cooled. The separated white crystalline compound was filtered, washed with ethanol followed by ether and dried *in vacuo*. (Found: Mn, 9.83%, Br, 30.5%; Mn $N_8 H_{16} C_4 S_4 Br_2$ requires Mn, 10.58%; Br, 30.7%). Before estimating the halogen, thiourea was destroyed as it forms a complex with silver. The compound melted at 179° C. It is essentially a non-electrolyte in acetone medium ($\Lambda_m = 32.0$ mhos). In solid form, the compound is paramagnetic indicating 5 unpaired electrons ($\mu_{eff} = 6.03$ B.M.). Similar attempts to prepare the thiourea complexes of manganous iodide and thiocyanate were unsuccessful and only thiourea separated out on cooling.

In accordance with the electroneutrality principle of Pauling, the metal ion takes up such a number of ligands as will reduce its charge to nearly zero. In case of weakly polarisable ligands, the charge transfer in each metal-ligand σ -bond is relatively small and

hence the co-ordination number can be larger. The polarisability of the chloride, bromide and iodide ligands follows the order: $I > Br > Cl$. Since iodide has the highest polarisability, it is reasonable to think that the hexa-co-ordinated complex $Mn tu_4 I_2$, is not formed to avoid unwanted accumulation of negative charge on the central atom. Even with bromide, the compound is formed only with difficulty. This explanation is, however, not always true since a highly polarisable ligand like cyanide prefers hexa-co-ordination. While Pauling's electroneutrality principle is the real guide to decide the preferred co-ordination number and/or the stability of the complex formed, the extent of participation of the donor pair of electrons for achieving electroneutrality is conditioned by several other factors besides polarisability of the ligand.

Department of Chemistry, K. C. DASH.
Regional Engg. College, D. V. RAMANA RAO.
Rourkela-8, December 14, 1965.

1. Goldenburg, N., *Trans. Farad. Soc.*, 1940, **36**, 847.
2. Rosenheim, A. and Meyer, V. J., *Z. anorg. chem.*, 1906, **49**, 17.
3. Dash, K. C. and Ramana Rao, D. V., *Ind. J. Chem.*, 1965, **3**, 514.

A CHEMICAL EXAMINATION OF *QUERCUS ROBUR* AND *QUERCUS* *INCANA*

Quercus species have been traditionally important for their tanning properties and as such have been investigated mainly for their tannin content from time to time. During the course of our investigation on various Indian woods, the two *Quercus* species, namely *Q. robur* L. and *Q. incana* Roxb., have now been examined and the results are reported below.

The bark of *Q. robur* was studied earlier for its tannin content by Mayer,¹ who isolated (+) catechin and (+) gallo catechin and later by Hathway² who in addition isolated leucocyanidin and leucodelphinidin. Wrzeciono³ examined the triterpenoids of the bark and reported the isolation of friedelin, friedelan-3- α -ol, β -sitosterol, glutin-5(6)en-3-one, glutin-5(6)en-3- β -ol. We have now investigated the stem bark and heartwood of a sample of *Q. robur* collected from Manali range (6,500 ft.).

The bark was first extracted with hot light petroleum (60-80°) and then with acetone in the cold. The light petroleum extract was chromatographed on neutral alumina. Elution with light petroleum: benzene (1:1) furnished

friedelin as the first fraction, m.p. 255-57°; oxime m.p. 288-90°. It showed complete agreement with an authentic sample of friedelin on thin-layer chromatography and the mixed m.p. was undepressed. Subsequent elution of the column with light petroleum: benzene (1:4) gave a second fraction which crystallised from ethyl alcohol as plates, m.p. 299-301°. It was identified as 3- α -friedelanol by comparison with an authentic sample on T.L.C. and the mixed m.p. was undepressed. The acetone-soluble portion of the bark after concentration was extracted successively with ether and ethyl acetate. The ether extract yielded quercetin, m.p. 308-10°; pentamethyl ether, m.p. 150-51° undepressed by an authentic sample of quercetin pentamethyl ether. The ethyl acetate-soluble portion contained a mixture of leucoanthocyanidins which on treatment with alcoholic hydrochloric acid gave mainly pelargonidin chloride as the flavylum chloride which was identified through absorption spectra, chromatography and colour reactions.

The heartwood of *Q. robur* was extracted first with hot light petroleum and then with ether and acetone in the cold. The light petroleum extract gave mainly waxy materials which did not respond to the Liebermann-Burchard test. The ether extract gave quercetin, identified by its m.p., chromatography, co-chromatography and absorption spectra. The acetone extract gave mainly leucopelargonidin as shown by its conversion to pelargonidin chloride with alcoholic hydrochloric acid and characterisation of the latter in the usual manner.

Quercus incana (Indian oak and locally known as 'Bhanj') is an indigenous timber tree which grows in Central Himalayas at a height of 6,000-8,000 ft. During the present investigation, the leaves and stem bark have been examined.

The air-dried leaves were extracted successively with light petroleum, ether and ethyl alcohol in a Soxhlet. The light petroleum extract on concentration deposited an amorphous solid which gave positive Liebermann-Burchard test. Thin-layer chromatography revealed the presence of six spots, the detailed examination of which is in progress. The ether extract on concentration gave a mixture of two flavonoids which were separated by preparative paper chromatography using 25% acetic acid as eluent. One of these was shown to be quercetin through the study of its absorption spectra and its pentamethyl ether, m.p. 150-51°, undepressed by an authentic sample of quercetin pentamethyl ether. The second component was found to be

a new 3-disaccharide of quercetin as shown by the study of its ultra-violet absorption spectra in the presence of reagents λ_{\max} in $m\mu$ 260, 354 (in methanol); 270, 312, 365 (with NaOAc); 260, 290, 366 (with NaOAc- H_3BO_3); 270, 405 (with $AlCl_3$); 270, 390 (with NaOEt). R_f BAW^b (4, 1, 5) 0.75, PhOH- H_2O ^a 0.67, 25% HOAc 0.72, Forestal solvent 0.90.

Hydrolysis with aqueous H_2SO_4 (7%) gave quercetin and galactose and arabinose, the sugars being identified through their co-chromatography with standard samples in three different solvent systems namely BAW^b (4, 1, 5), phenol-water^a and butanol-acetone-water (4, 5, 1).

The stem bark of *Q. incana* has also been examined and found to contain two triterpenoids and a mixture of leucoanthocyanidins. The stem bark was extracted first with light petroleum and then with acetone. The light petroleum extract was concentrated and subsequently chromatographed on neutral alumina. Elution with light petroleum: benzene (1:1) gave friedelin, m.p. and mixed m.p. 256-57°; $[\alpha]_D^{21}$ -27.5° (in $CHCl_3$); oxime, m.p. 288-90°. Further elution with benzene gave β -sitosterol, m.p. 136-37°; $[\alpha]_D^{21}$ -33° (in $CHCl_3$). Mixed m.p. with an authentic sample of β -sitosterol was undepressed. Maceration of the acetone extract with ether gave no ether-soluble portion. Subsequent extraction with cold ethyl acetate furnished mainly leucopelargonidin which was identified as given above.

This research has been financed in part by a grant made by the United States Department of Agriculture under PL-480.

Department of Chemistry, V. K. KALRA.
University of Delhi, A. S. KUKLA.
Delhi-7, January 5, 1966. T. R. SESHADRI.

1. Mayer, W. and Baum, G. *Das Lader*, 1956, 7, 33; *Ann.*, 1958, 611, 264.
2. Hathway, D. E., *Biochem. Jour.*, 1958, 70, 34.
3. Wrzeciono, U., *Koczniki Chem.*, 1963, 37, 1457.
BAW^b = Butanol-acetic acid-water, upper layer.

**CHEMICAL COMPONENTS OF
GANODERMA APPLANATUM (PERS.
ex FR.) PAT. AND STEREUM]
PRINCEPS JUNGH**

Ganoderma applanatum (Pers. ex Fr.) and *Stereum princeps* Jungk are wood rotting fungi on which no chemical information is available.¹ We record here the results of our chemical study of these. They were collected personally by one of the authors in Western Himalayas, the former at a location between Bhundiyar village and Ganghariya and the latter at a place called Sukh Tal.

G. applanatum was extracted with petroleum ether, chloroform and alcohol in succession. The petroleum ether extract (yield, 1.0%) was chromatographed over neutral alumina. Petroleum ether-benzene (1:1) and benzene eluted a substance which crystallised from chloroform-methanol as colourless thick rods, m.p. 103-04°, $[\alpha]_D^{25}$ -24° (chloroform), formula $C_{28}H_{42}O$ and U.V. absorption max. 284 $m\mu$ (chloroform) $\log \epsilon$ 4.38. From these properties and colour reactions it appeared to be isoergosterone and this was confirmed by mixed melting point and superimposable I.R. spectra with an authentic specimen from *Fomes fomentarius*.² From the same chromatogram benzene-chloroform (1:1) and chloroform eluted a second substance, colourless needles from acetone, m.p. 163-64°, $[\alpha]_D^{25}$ -120.4° (chloroform), formula $C_{28}H_{44}O$, H_2O ; U.V. absorption max. at 260, 271, 282 and 293 $m\mu$ (methanol); acetate m.p. 176-78°, $[\alpha]_D^{25}$ 85.4° (chloroform). The substance appeared to be ergosterol and this was confirmed by mixed melting point and superimposable I.R. spectra employing authentic ergosterol.

The chloroform extract of the fungus (yield, 0.42%) and the subsequent alcoholic extract (yield, 0.62%) were deep brown semi-solids. They were separately taken in ethyl acetate and extracted successively with aqueous sodium bicarbonate, sodium carbonate and sodium hydroxide solutions. The remaining neutral ethyl acetate solution yielded a small quantity of ergosterol in each case. The fractions recovered from the six alkaline extracts and tested separately gave positive ferric reaction and underwent reversible decolorisation with sodium dithionite (indication for quinones), melted with decomposition indefinitely at temperatures above 300° and showed the presence of four components on paper chromatography. Closer study of these six fractions was not pursued.

Stereum princeps was extracted with petroleum ether, ether and acetone in succession. Chromatography of the petroleum ether extract (yield, 0.7%) over neutral alumina yielded ergosterol from the chloroform eluate, colourless needles, m.p. 164-65°, identity confirmed by comparison with authentic specimen and preparation of the acetate. The other chromatographic fractions were amorphous.

The deep yellow ether extract (yield, 0.14%) was chromatographed over neutral alumina. The petroleum ether eluate yielded a colourless substance, m.p. 63-65°, which resisted acetylation and alkaline hydrolysis did not show positive colour reaction with ferric chloride or

2, 4-dinitrophenylhydrazine, did not decolorise bromine in chloroform solution and analysed for an aliphatic hydrocarbon. It remained unaffected on heating with amyl alcohol-hydrochloric acid (1:1). The product thus purified had a m.p. 63.4–63.8°. According to the melting point-composition chart of Piper *et al.*³ it seems to be an equimolecular mixture of C₂₇, C₂₉ and C₃₁ paraffins. The chloroform eluate of the same chromatogram gave ergosterol as colourless needles, m.p. 164–65°.

The acetone extract (deep brown semi-solid, 0.31%) was repeatedly extracted with ether. The ether insoluble fraction gave a positive ferric reaction and was sparingly soluble in all organic solvents; it was not studied further. The ether solution was handled in the same way as the ethyl acetate solution of the chloroform extract and the alcohol extract of *G. applanatum*. The neutral ether solution yielded ergosterol as colourless needles, m.p. 164–65°, and the three alkaline extracts exhibited the same colour reactions and melting and paper chromatographic behaviour as the corresponding extracts of *G. applanatum*.

The authors are grateful to Prof. T. R. Seshadri, F.R.S., for his kind interest and Dr. B. K. Bakshi for the identification of the fungi. One of us (P. S.) thanks the Council of Scientific and Industrial Research, New Delhi, for a Junior Research Fellowship.

Department of Chemistry,
University of Delhi,
Delhi-7, February 1, 1966.

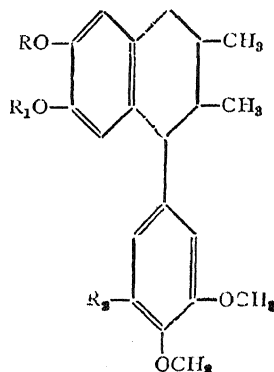
PRATAP SINGH.
S. RANGASWAMI.

1. Shibata, S., Natori, S. and Udagawa, S., *List of Fungal Products*, University of Tokyo Press, Tokyo, 1964.
2. Pratap Singh and Rangaswami, S., *Indian J. Chem.*, 1965, **3**, 575.
3. Piper, S. H., Chibnall, A. C., Hopkins, S. D., Pollard, A., Smith, J. A. B. and Williams, E. F., *Biochem. J.*, 1931, 2086.

LIGNANS

Part V. Synthesis of Analogues of Galbulin

The lignans galbulin (Ia) and galcatin (Ib) have been isolated by Huges and Ritchie¹ from the Australian species—*Himantandra baccata* Bail. Their structures have been assigned by degradation and interconversion. The present communication describes the synthesis of two isomers of 2, 3-dimethyl-4 (3', 4', 5'-trimethoxyphenyl)-6, 7-dimethoxy-1, 2, 3, 4-tetrahydronaphthalene (Ic), which are analogous to galbulin (Ia).



(Ia) $R=R_1=-CH_3$; $R_2=H$

(Ib) $R, R_1=CH_2$; $R_2=H$

(Ic) $R-R_1=-CH_2$; $R_2=-CCl_3$

3-Carbomethoxy-2-hydroxymethylene-4-(3', 4', 5'-trimethoxyphenyl)-6, 7-dimethoxy-1-tetralone² was reduced with hydrogen over palladised carbon. The product obtained was chromatographed over alumina and two isomeric 3-carbomethoxy-2-methyl-4-(3', 4', 5'-trimethoxyphenyl)-6, 7-dimethoxy-1-tetralones (A and B) were isolated. (A) on crystallisation from benzene had a melting point 177° (Found: C, 65.5; H, 6.3. C₂₅H₃₀O₈ requires C, 65.5; H, 6.5%). $\lambda_{\text{max}}^{\text{alc}}$ 235, 275 and 310 m μ ($\log \epsilon$, 4.5, 4.22 and 3.94). (B) was crystallised from a mixture of benzene-petroleum ether (b.p. 40–60°) in needles, m.p. 167° (Found: C, 65.7; H, 6.6. C₂₅H₃₀O₈ requires C, 65.5; H, 6.5%). $\lambda_{\text{max}}^{\text{alc}}$ 235, 276 and 305 m μ ($\log \epsilon$, 4.64, 4.19 and 3.9). The mixed melting point of (A) and (B) was 157°. The methyltetralone ester (A) was hydrolysed with alcoholic alkali to 3-carboxy-2-methyl-4-(3', 4', 5'-trimethoxyphenyl)-6, 7-dimethoxy-1-tetralone. The acid was crystallised from ethyl acetate in fine needles, m.p. 252° (Found: C, 64.4; H, 6.1. C₂₃H₂₆O₈ requires C, 64.2; H, 6.0%). The methyltetralone (B) on hydrolysis gave an acid m.p. 252° A mixed melting point with the one obtained from (A) showed no depression. The methyltetralone esters (A) and (B) were also obtained by the reduction of 2-acetoxy-methylene-3-carbomethoxy-4-(3', 4', 5'-trimethoxyphenyl)-6, 7-dimethoxy-1-tetralone² with hydrogen over palladised carbon or Raney nickel and purification of the reduced product by chromatography.

The methyltetralone (A) was subjected to Clemmensen reduction and 3-carbomethoxy-2-methyl-4-(3', 4', 5'-trimethoxyphenyl)-6, 7-dimethoxy-1, 2, 3, 4-tetrahydronaphthalene thus obtained was crystallised from ethyl acetate in fine needles, m.p. 151° (Found: C, 67.7;

H, 6.9. $C_{25}H_{32}O_7$ requires C, 67.6; H, 7.2%). The tetralin ester was reduced with lithium aluminium hydride in tetrahydrofuran to 3-hydroxymethyl-2-methyl-4-(3', 4', 5'-trimethoxyphenyl)-6, 7-dimethoxy-1, 2, 3, 4-tetrahydronaphthalene, m.p. 176° (Found: C, 68.3; H, 7.4. $C_{23}H_{30}O_6$ requires C, 68.6; H, 7.4%). Its tosylate was reduced with lithium aluminium hydride in tetrahydrofuran, the reaction product was chromatographed over alumina and 3-dimethyl-4-(3', 4', 5'-trimethoxyphenyl)-6, 7-dimethoxy-1, 2, 3, 4-tetrahydronaphthalene (C) was isolated, m.p. 124° (Found: C, 71.2; H, 7.9. $C_{23}H_{30}O_5$ requires C, 71.5; H, 7.7%).

Similarly the isomeric methyltetralone (B) on Clemmensen reduction and chromatography over alumina gave 3-carbomethoxy-2-methyl-4-(3', 4', 5'-trimethoxyphenyl)-6, 7-dimethoxy-1, 2, 3, 4-tetrahydronaphthalene, m.p. 125° (Found: C, 67.4; H, 7.1. $C_{25}H_{32}O_7$ requires C, 67.6; H, 7.2%). The reduction of the tetralin ester with lithium aluminium hydride in tetrahydrofuran yielded 3-hydroxymethyl-2-methyl-4-(3', 4', 5'-trimethoxyphenyl)-6, 7-dimethoxy-1, 2, 3, 4-tetrahydronaphthalene, m.p. 159° (Found: C, 68.6; H, 7.5. $C_{23}H_{30}O_6$ requires C, 68.6; H, 7.4%). The crude tosylate of the carbinol was reduced with lithium aluminium hydride. The oily product was chromatographed over alumina, to yield 2, 3-dimethyl-4-(3', 4', 5'-trimethoxyphenyl)-6, 7-dimethoxy-1, 2, 3, 4-tetrahydronaphthalene (D), m.p. 98° (Found: C, 71.5; H, 7.7. $C_{23}H_{30}O_5$ requires C, 71.5; H, 7.7%).

The above series of reactions constitutes the synthesis of two isomeric lignans analogous to galbulin (Ia). Detailed investigations including the stereochemistry will be reported elsewhere.

Department of Chemistry, H. D. SHROFF.
Institute of Science, A. B. KULKARNI.
Bombay, December 22, 1965.

1. Huges, G. K. and Ritchie, E., *Australian J. Chem.*, 1954, 7, 104.
2. Shroff, H. D., Diwadkar, A. B. and Kulkarni, A. B., *Indian J. Chem.*, 1964, 2, 190.

A NEW TYPE OF INSOLUBLE OXALATE IN THE LEAVES OF BATHUA (*CHENOPODIUM ALBUM* L.)

EVIDENCE for the presence of a new type of insoluble oxalate other than calcium oxalate in the leaves of *Chenopodium album* L. was demonstrated by Singh and Sur.¹ It was reported that the entire calcium content of the leaf could account for only 45% of the total

insoluble oxalate and the major part constituting a substantial portion of the leaf (at least 5% of dry leaf) existed in some unknown form not identical with calcium oxalate. This insoluble oxalate may differ from calcium oxalate in its role on the utilisation of dietary calcium. The present work was, therefore, undertaken to establish the nature of this unknown insoluble oxalate in the green leaves.

Chenopodium album L. was grown in experimental plots. Its leaves were collected and used as fresh as possible.

Soluble and Insoluble Portion of the Leaves.—Fresh leaves (100 gm.) were thoroughly washed and homogenised in a blender with about 200 ml. water. The homogenate was quantitatively transferred to a beaker and two drops of decanol were added to it. The contents were boiled for 15 min., left overnight at room temperature and then filtered through a weighed Whatman No. 1 filter-paper. The residue was washed well with water. The washings and the filtrate were mixed and diluted to 500 ml. Soluble oxalate, calcium and magnesium were estimated in this portion. The residue left on the filter-paper was dried at 100° C. and weighed after cooling in a desiccator. This residue was termed as the *insoluble portion of the leaves*. From a known quantity of the insoluble portion, green colouring matter (chlorophylls, etc.) was removed by ethanolic extraction in Soxhlet apparatus. A weighed portion (about 2 gm.) of Ifc. (Insoluble portion of leaf free of green colouring matter) was boiled with 200 ml. N-HCl for 15 min., cooled and filtered through a Whatman No. 40 filter-paper. The residue was washed well with water. The washings and filtrate were diluted to 250 ml. and total insoluble calcium, magnesium and oxalate were estimated in this portion.

Determination of Calcium, Magnesium and Oxalate.—Calcium in almost neutral solutions (neutralised with dilute ammonia) was estimated in presence of magnesium by EDTA method² modified by Knight.³ Magnesium was also estimated by using titrimetric EDTA method⁴ using eriochrome black T as an indicator. The titre value in this case was for both calcium and magnesium together. The amount of magnesium was calculated by difference.

Insoluble and soluble oxalates were determined in 10 ml. aliquots using Baker's method.⁴

Effect of pH on the Solubilities of Magnesium Oxalate, Magnesium Phosphate and Unknown Oxalate in Leaves.—Saturated solutions of magnesium oxalate, magnesium phosphate and

Ifc. (used for its unknown oxalate) were prepared by mixing sufficient quantities of these substances in 20 ml. universal buffer⁵ of varying pH values at 37°C. Magnesium was estimated in aliquots after tenfold dilution and amounts (gm./litre) were plotted against pH.

RESULTS AND DISCUSSION

The results† of the analysis of the fresh leaves of the mature Bathua plant were as follows: moisture, 85%; soluble magnesium, 0.074; soluble oxalate (C_2O_4), 8.25; insoluble residue, 55.23; insoluble calcium, 1.44; insoluble magnesium, 0.654 and insoluble oxalate (C_2O_4), 5.54.

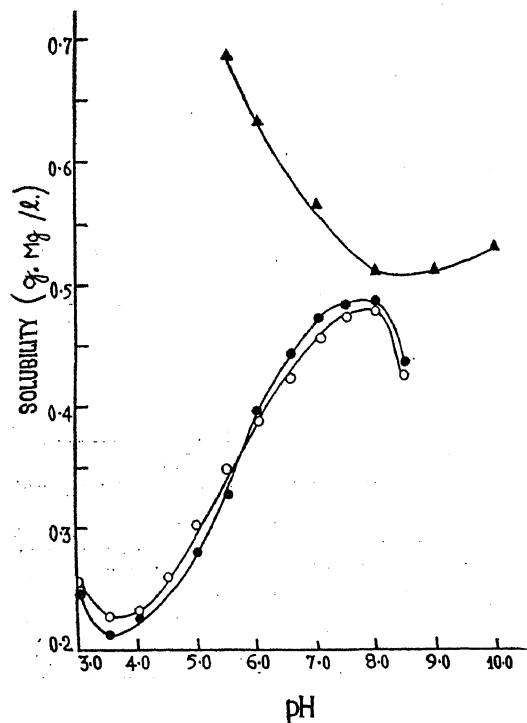


FIG. 1. A comparison of the solubilities at 37° of magnesium oxalate (O-O-O-O) and magnesium phosphate (▲-▲-▲-▲) with the substance present in the insoluble portion free of green colouring matter of *Chenopodium album* L. (●-●-●-●) in universal buffer of varying pH values.

It would be seen that 42.6% of the total insoluble oxalate could not be accounted for as calcium oxalate. The leaves of the plant, therefore, contained a large amount of a new type of insoluble oxalate. Comparison of the observed values (5.54) for total insoluble oxalate with that calculated for chemical combination with existing calcium (3.18) and magnesium (2.37) shows very close stoichiometry and, therefore, total insoluble oxalate

could be accounted for as calcium and magnesium oxalates.

Identical solubilities of magnesium oxalate and of the substance in Ifc. at varying pH values (Fig. 1) leave little doubt about their similarity in character. This type of similarity in their solubilities was also observed when acetic acid and sodium acetate buffer of varying pH values was used. These observations may, therefore, be taken as evidences demonstrating the presence of magnesium entirely as magnesium oxalate in the insoluble portion (Ifc.) of *Chenopodium album* L.

Magnesium oxalate which we have shown to occur in the insoluble portion of *Chenopodium album* L. may not be harmful as soluble oxalate or as harmless as insoluble calcium oxalate as far as calcium utilisation is concerned. Further work on the role of magnesium oxalate in calcium utilisation and its isolation from leaves is under progress.

This work was made possible by the generous award of a Research Scheme by the State Council of Scientific and Industrial Research, U.P.

Dept. of Physiology, NIYAM CHARAN SHARMA.
G.S.V.M. Med. College, BIMAL KUMAR SUR.
Kanpur, October 15, 1965.

* Details of the method will appear elsewhere.

† Results expressed as gm. per cent. of dry leaf.

1. Singh, P. P. and Sur, B. K., *Curr. Sci.*, 1962, **31**, 333.
2. Welcher, F. J., *The Analytical Uses of Ethylenediamine Tetra Acetic Acid*, D. Van Nostrand Co., Inc. (Princeton), 1958, p. 104.
3. Knight, A. G., *Chem. and Ind.*, 1951, p. 1141.
4. Baker, C. J. L., *Analyst*, 1952, **77**, 340.
5. Vogel, A. I., *Quantitative Inorganic Analysis*, Longmans, Green & Co., Ltd. (London), Second Ed., 1955, p. 872.

A FOSSIL FRUIT FROM THE DECCAN INTERTRAPPEAN BEDS OF MOHGAONKALAN, MADHYA PRADESH

The fossil fruit described in the present communication was found embedded in a piece of chert collected by the authors from the Deccan Intertrappean beds of Mohgaonkalan (21° 1' N; 79° 11' E.), district Chhindwara, Madhya Pradesh.

The specimen was fragile and dark grey or almost black in colour. It was broadly ovoidate, measuring about 1.1 cm. in height and 1.2 cm. in width (Fig. 1). Its internal structure could not be studied as the specimen crumbled down while sectioning. The epicarp was not

preserved. A thin mesocarp was seen with a number of vertical striations (Fig. 1). On one side of the fruit a thin ridge (Fig. 1) arose



FIGS. 1-2. *Carpolithus striatus* sp. nov. Fig. 1. Lateral view of the fossil showing the striated mesocarp and the ridge, $\times 2$. Fig. 2. Basal view of the fossil fruit, $\times 2$.

nearly from the base, becoming prominent almost near the apex. The ridge measured about 0.7 cm. in length and about 1.5 mm. in maximum height. There was a round shallow depression at the base (Fig. 2).

There are no striking features in this fossil fruit which may help in its taxonomic identification. The vertical striations on the surface of the mesocarp might suggest that it was fibrous and the fruit probably a palm. However, from the scanty information available, the fruit cannot be identified taxonomically. Therefore, it has been thought best to refer this fossil fruit to the genus *Carpolithus* L. as *Carpolithus striatus* sp. nov.

The authors are thankful to Dr. R. N. Lakhanpal, for helpful suggestions.

Biology Department, R. K. JAIN.
Osborn Memorial Laboratories,
Yale University,
New Haven, Connecticut, U.S.A.,
and

Birbal Sahni Institute R. DAYAL.
of Palaeobotany,
Lucknow, November 19, 1965.

DEDOLOMITISATION

WITH reference to the letter on "Diagenetic dedolomitisation in the Krol Series" by C. Gundu Rao (*Curr. Sci.*, 1964, 33, 682), I wish to bring out the following facts to clarify some of the observations and interpretations mentioned therein:

Firstly, the diagenetic dedolomitisation of dolomites is not a rare feature as mentioned by Gundu Rao but is widely distributed in rocks of different areas and geological ages. The only misfortune is that we are not always able to distinguish this phenomenon from dolomitisation.

Secondly, the process which brings about dedolomitisation of dolomite is not diagenesis but regressive epigenesis or weathering. In this context I wish to refer the works of V. B. Tatarsky (1949, 1953). He has clearly and authentically (on the basis of field and laboratory observations) shown that dedolomitisation is a surface phenomenon and is brought about in the already compact or ready rock (dolomite) by chemical weathering. The recent investigations by the author of this letter of the carbonate rocks of Western Turkmenia (U.S.S.R.) clearly support the views of Tatarsky. The term "Diagenesis" cannot be used in such a wide context or for such varied processes as is used by Gundu Rao. Any change which takes place in the solid rocks is brought about by epigenesis, and not by diagenesis. In English literature also, lately it has been emphasised that dedolomitisation is brought about by surface processes rather than by diagenesis (Taylor, 1961).

Thirdly, besides the two instances mentioned in the note, there are other instances of the observations of this process recorded and published in English literature namely Shearman, Khouri and Taha, 1961; Evamy, 1963, etc.

Geology Faculty, N. K. SRIVASTAVA.
Leningrad State Univ.,
Leningrad (U.S.S.R.), January 19, 1966.

1. Tatarsky, V. B., *Razdolomichivanie i svyazanny s nim voprosy*, vest LGU, No. 1, 1949.
2. —, *O rasprostranennosti razdolomichivanniy porod*, Doklady AN SSSR, 1953, 69 (6).
3. Shearman, D. J., Khouri, J. and Taha, S., "On the replacement of dolomite by calcite in some Mesozoic limestones from French Jura," *Proc. Geol. Assoc. Engl.*, 1961, p. 72.
4. Taylor, J. H., Remarks on the article of Shearman et al., *Ibid.*, 1961, p. 72.
5. Evamy, B. D., "The application of a chemical staining technique to a study of dedolomitisation," *Sedimentology*, 1963, 2 (2).

LOWER SIWALIK PLANTS FROM NEAR JAWALAMUKHI, PUNJAB

ALTHOUGH the occurrence of fossil plants in the Siwalik system is known since long, the number of forms described therefrom is very poor. We have come across an exposure of Lower Siwalik beds about 12 kilometres north-west of Jawalamukhi, Punjab, from where a large number of fossil plants have been collected by us. These are in the form of impressions, mostly of dicotyledonous leaves, borne on fine-grained sandstone and shale. Amongst them the occurrence of *Zizyphus* has recently been reported by one of us (R. N. L.).¹

On further investigation three more forms have been found whose characteristic features indicate quite a dependable resemblance with certain living plants.

texture seems subcoriaceous. Leaves similar in general structure and size are met with in some modern species of *Smilax*, e.g., *S. macrophylla*, *S. roxburghiana* and *S. prolifera*.



FIGS. 1-3

The first is a broadly ovate or oval leaf (Fig. 1), about 14 cm. long and 11 cm. wide, with five strong veins arising from near the base and reaching almost up to the apex. Another pair of faint veins runs along the margin. A large number of finer branches are seen running across the main veins, arising at about 60-70°. The margin is entire and the

The second is also a leaf-impression (Fig. 2), elliptical in shape and measuring about 6 cm. in length and 2.5 cm. in width. Its apex is almost rounded and the base seems acute. It has a strong midrib with 8-9 pairs of subopposite secondaries arising at about 60° and running curved up to the margin where they bend and join the next higher member in a loop. The

tertiaries run slantingly across the secondaries and the finer branches form characteristic polygonal meshes. In general look and texture this fossil shows resemblance with the small-leaved species of *Lagerstroemia*.

The third is an impression of a narrow, elliptical, winged fruit (Fig. 3), slightly rounded above and elongate-cuneate below. One of the lateral sides is more rounded than the other. There is a suggestion of a thick seedlike body in the middle of the wing. In general it strongly recalls the fruit of *Dalbergia sissoo*.

All the three forms reported here, along with others in the collection, are under study. Their detailed descriptions and affinities will be published after comparing them critically with living plants in some large herbarium.

Birbal Sahni Institute of R. N. LAKHANPAL.
Palaeobotany, R. DAYAL.
Lucknow, November 16, 1965.

1. Lakhanpal, R. N., *Curr. Sci.*, 1965, 34, 666.

A NOTE ON THE SANIDINE-(TRACHYTE) FROM THE WESTERN SLOPES OF RAJPIPLA HILLS, GUJARAT

BLANFORD (1869) and Bose (1908) reported the occurrence of trachytic rocks among the basalts on the western slopes of the Rajpipla Hills. Of these, a plug of trachytic intrusive into the basalt forms the Karia Hill ($21^{\circ} 14' : 73^{\circ} 17'$). Many other smaller hillocks of the same rock occur in the east to south-east direction within half a mile. The present paper is an attempt to study the petrographical characters of these rocks.

The rocks constituting these hills have low

specific gravity (2.51) and a grey-white to yellow colour with macrophenocrysts of feldspar in an aphanitic groundmass. Flow lines are also visible which appear folded at places.

The majority of the phenocrysts, under the microscope, appear to be sanidine and sanidine-microperthite with a small amount of plagioclase. Rosenblum's (1956) sodium-cobalt-nitrate staining technique shows that the major elements, including the phenocrysts, consist of K-feldspars and the rest plagioclase (phenocrysts) and quartz (groundmass). Sanidine phenocrysts (average size 6 mm.) are mostly idiomorphic (Fig. 1) but may show corroded outlines. Incipient sericitization and alteration into calcite are their common features, otherwise the unaltered portions are water-clear. Inclusions of skeletal crystals have also been noted. Generally their $2V$ is very small, almost 0° , and thus they appear uniaxial. But higher values, $2V \alpha = 42^{\circ}$ II (010) plane, have also been recorded, suggesting solid-solution between the K- and Na-feldspars. The extinction angle, generally, is 0° but varies with the soda content. The maximum value noted (in sodic variety) is $\alpha \Delta \alpha' = 10^{\circ}$. The refractive index: $\beta = 1.525$. On Tuttle's graph (1952) the composition $Or_{70} (Ab + An)_{30}$ is obtained. Microperthitic intergrowth is not uncommon (Fig. 2). When twinning is present it is on Carlsbad law (Fig. 1). Sanidine also forms rims around some plagioclase feldspars.

The plagioclase phenocrysts are less abundant and of smaller size (average 1.3 mm.). The most common twinning is on albite law but albite-Carlsbad combination is also fairly represented. Their $2V \alpha = 83^{\circ}$; the maximum extinction angle in the "symmetrical zone" is 10° , thus showing a composition $Ab_{72} An_{28}$.



FIGS. 1-3. Fig. 1, $\times 23$. Fig. 2, $\times 75$. Fig. 3, $\times 30$.

Zoning is present, plagioclase-iron-ore intergrowth is also seen.

The general groundmass is very fine-grained, granular, consisting almost entirely of K-feldspar (sanidine?) and quartz forming 'mosaic' structure which becomes more or less micrographic at places. Some dirty brownish patches probably represent the alteration product of original mafic constituents. Small faintly pleochroic laths of biotite appear resorbed to the extent of total destruction and alteration into finely granular iron-ore and chlorite (Fig. 3). Their arrangement is somewhat fluxional. Iron-ores are present as grains of various sizes and shapes.

The greater value of 2V and the orientation of optic axial plane II (010) in sanidine suggest a higher temperature condition at the time of crystallization. Cooling brings in exsolution and change of optical properties which, also, depend on the internal structures of K-feldspars. Because of rapid cooling the higher temperature and transitional optics remain almost unaffected, hence, the latter possibility is eliminated. Zoning is very rare in alkali feldspars. Hsu (1954) noticed zoning in sanidine and Chaisson (1950) in adularia. These are due to compositional variation in former and structural variation in the latter. It appears logical that zoning in sanidine from Karia is due to Or/Ab variation from the core to the margin but the author feels that a detailed investigation will be necessary to establish this.

On account of the abundance of sanidine and absence of quartz phenocrysts the rock is classed as 'sanidine trachyte' and is being described for the first time in India. It, however, appears to be slightly more acidic. It is clearly younger than the tholeiitic basalts which it intrudes.

Other occurrences of trachytic rocks in India have been recorded from Salsette Island (Krishnan, 1929; Kalapesi and Contractor, 1935), Kawant (Bose, 1908; Chatterjee, 1963) and Phenaimata (Bose, 1908). The former are more acidic and granophyric whereas the last two are probably more basic.

The author expresses his gratitude to Dr. S. C. Chatterjee, Professor of Geology, Vikram University, under whose guidance this work has been carried out. Acknowledgement is made to the Council of Scientific and Industrial Research, for the award of a fellowship. The author is also thankful to Dr. F. Ahmad for his kind encouragement.

Department of Geology,
Aligarh Muslim University,
Aligarh, July 26, 1965.

NOMAN GHANI.

1. Ansilewski, J., *Archiwum Geologiczne*, 1959, **3**, 1.
2. Blanford, W. T., *Mem. Geol. Surv. Ind.*, 1869, **6**, Pt. 3.
3. Bose, P. N., *Rec. Geol. Surv. Ind.*, 1908, p. 21.
4. Chaisson, U., *Jour. Geol.*, 1950, p. 58.
5. Chatterjee, S. C., *Proc. 50th Ind. Sci. Cong.*, 1963, Abstracts.
6. Deer, W. A., et. al., *Rock Forming Minerals*, 1963, 4.
7. Emmons, R. C. and Gates, R. M., *Mem. Geol. Soc. Amer.*, 1953, p. 52.
8. Hsu, J., *Amer. Jour. Sci.*, 1954, p. 252.
9. Kalapesi, A. S. and Contractor, G. P., *Quart. Jour. Geol. Min. Met. Soc. Ind.*, 1935, **7** (4).
10. Krishnan, M. S., *Rec. Geol. Surv. Ind.*, 1929, p. 62.
11. Rosenblum, S., *Amer. Min.*, 1956, **26**, 662.
12. Tuttle, O. F., *Amer. Jour. Sci.*, Bowen Volume, 1952, p. 553.

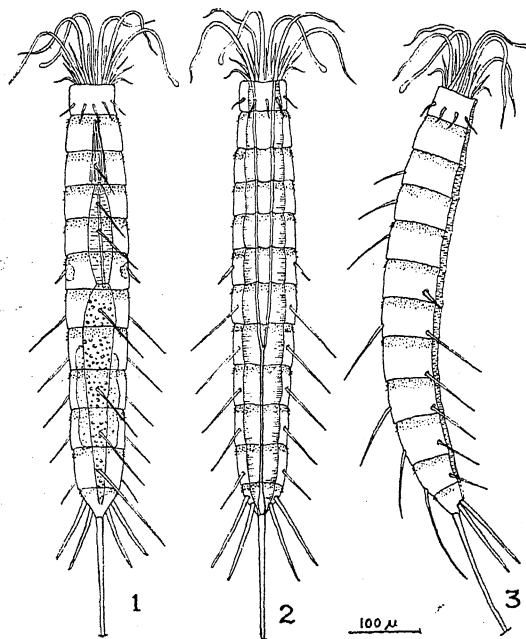
OCCURRENCE OF AN ABERRANT KINORHYNCH *CATERIA STYX* GERLACH, IN WALT AIR BEACH SANDS

DURING the past few years, an investigation of the beach sands of Waltair coast has revealed the existence of a variety of interstitial fauna belonging to the various invertebrate animal groups. A comprehensive report of the investigation is being published elsewhere. One of the interesting species encountered in the survey is the aberrant mesopsammic kinorhynch, *Cateria styx* Gerlach. The form is so far known to inhabit only the southern Atlantic coasts. The species has been described from Rio de Janeiro on the east coast of South America (Gerlach¹) and later it has been reported from Angola on the south-west coast of Africa (Delamare Deboutteville²). In the absence of adequate investigations of the interstitial fauna in other parts of the world, it is perhaps presumptuous to make any conclusions about the geographical distribution of the species. However, from the available knowledge it would appear that the form is temperature limited, restricted to the tropical belt.

The local specimens of *Cateria styx* (Figs. 1-3) conform to the original description of the type species except for minor variations in the number of scalds, length of the body spines, etc. The relative measurements of the body zonites and their spines are given in Table I.

The length of the adult specimens when extended varies from 480 to 530 μ excluding the tail spines while the body diameter varies from 66-72 μ . The dorsal sensory organ occurring between zonites 7 and 8 in the type specimen is not observed in the local forms.

The division of exoskeleton into lateral plates on the ventral side is indistinct. The structure of the cuticular ornamentation, scalids, pharyngeal cone and the crown of nine oral styles, resemble the type description.



FIGS. 1-3. *Cateria styx* Gerlach, Fig. 1. Dorsal view. Fig. 2. Ventral view. Fig. 3. Lateral view.

TABLE I

No. of the zonite	Zonite length in μ	Length of dorsal spine in μ	Length of lateral spine in μ
2	34	..	..
3	44	..	..
4	40	40	..
5	42	48	..
6	42	60	..
7	43	..	24
8	46	72	80
9	48	..	74
10	45	68	66
11	43	84	56
12	42	120	48
13	35	436	98

The forms were occasionally collected through most of the year in coarse and medium sands 20 cm. below surface near half-tide level. They showed preference for substrates with coarser sand grades between 300-600 μ in their mean diameter. The temperature in the habitat varied from 26°-30° C. while the salinity ranged from 24 to 34‰. The forms are sluggish, and gregarious in habits and appear omnivorous in their diet. They are highly thigmotactic and

adhere firmly to the substrate with the aid of the scalids and the body spines and lie motionless when subjected to a commotion in the environment due to wave action, etc. Sometimes, the animal anchors itself freely in the water by applying its caudal end spine to sand particles.

Dept. of Zoology, G. CHANDRASEKHARA RAO.
Andhra University, P. N. GANAPATI.
Waltair, November 16, 1965.

1. Gerlach, S. A.. *Kieler Meeresforsch.*, 1956, 12 (1), 120.
2. *Delamare Deboutteville, Cl.*, Hermann, Paris, 1960, 740.

MODIFICATION OF FLORAL PARTS INTO TUBERS IN POTATO

IN two previous communications abnormalities of floral parts of potato leading to carpelloid stamens³ and multicarpellary ovary¹ have been reported. Yet another abnormality described in this note has been observed in a hybrid selection of *Solanum tuberosum* L. SLB/Z 531 (progeny of the cross 1521 c (3) \times M.109.3).

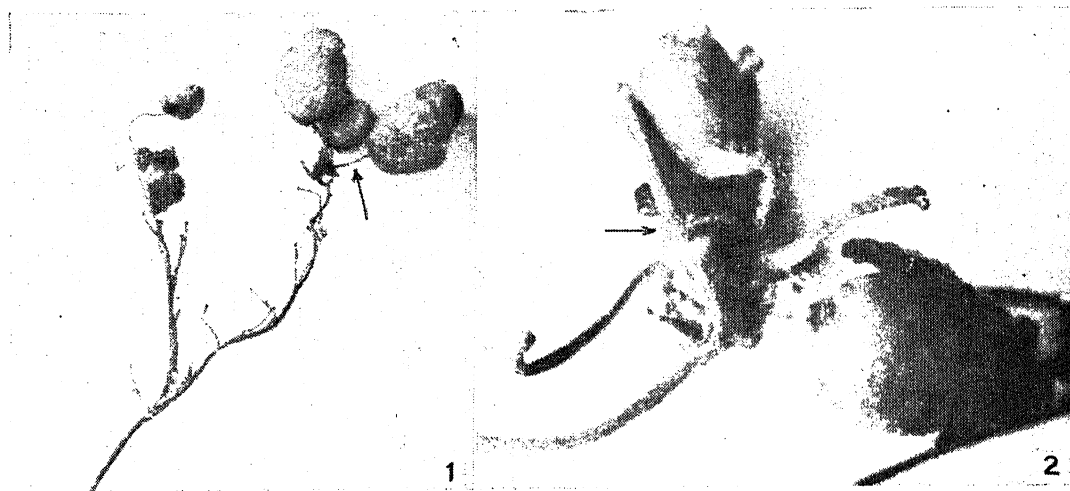
This hybrid produces normal flowers with 80% stainable pollen. During rainy season of 1964, three plants of this hybrid were observed to bear aerial tubers in place of berries. Fifteen such tubers were collected.

A study of the floral parts and the tubers formed revealed the following:

- (i) In three flowers the aerial tubers developed above the normal calyx and corolla (Fig. 2). One such tuber (of about 1 cm. size) was cut and it showed a cavity in the centre which enclosed an ovary and part of the style.
- (ii) In other cases the styles elongated to about 2 cm. above the persistent calyx and tubers formed at their ends (Fig. 1). In longitudinal sections such tubers appeared normal.

The tubers described above, after storage, have given rise to normal plants.

It is well known that potato plant produces tubers or tuberous swelling by accumulation of assimilates in the above-ground portions of stem if normal tuber formation underground is prevented by breaking the stolons⁴ or due to damage by fungal growth or cut in the stem when the translocation of assimilates is checked. Pushkarnath² observed an inflorescence bearing a number of sessile or sub-sessile tubers at the end of floral stalks in a sterile variety of *S. tuberosum* under conditions of excessive humidity. But in the observation described



FIGS. 1-2. Fig. 1. An abnormal inflorescence showing flowers modified into aerial tubers. Fig. 2. Close up of an aerial tuber showing persistent calyx.

here, the tubers developed by modification of corolla in one case and of the tip of style and stigma in another in a normal uninjured plant of a fertile variety.

Thus in potato aerial tubers can arise even in normal, undamaged plants at the end of floral stalk² and by modification of corolla and sexual parts. This may be of interest to morphologists since three different types of organs are involved in production of such aerial tubers.

Thanks are due to Dr. Pushkarnath, Director, for his interest in the work.

Central Potato Research
Institute,
Simla (India),
November 18, 1965.

S. K. BHATIA.
HARI KISHORE.
R. T. SHARDA.

1. Gaur, P. C., Kishore, H. and Singh, G. "A multicapillary condition in a plant of *Solanum chacoense* Bitt." (in press).
2. Pushkarnath, *Potato in India—Varieties*, Indian Council of Agricultural Research, 1964.
3. Sirohi, S. S., Kishore, H. and Khanna, M. L., *Experientia*, 1964 **20**, 615.
4. Thijia, G. A., *Enphytica* 1959, **8**, 95.

A NOTE ON THE PEST COMPLEX OF HYBRID JOWAR IN THE TUNGABHADRA PROJECT AREA OF MYSORE STATE

LARGE-SCALE cultivation of Hybrid Jowar (Juar) and Maize in the Tungabhadra Project area and other districts of Northern Mysore has been taken up in the current summer season. The substantial assistance by way of fertilisers

made available by the Oxford Committee for Famine Relief (OXFAM) has given an added impetus to this programme. The author had the opportunity of studying the incidence of insect pests of Hybrid Jowar in a recent tour covering Bellary, Raichur, Dharwar and Shimoga Districts. Since Hybrid varieties are expected to be grown in extensive areas in the next Kharif season and thereafter, it is desirable to make a clear appraisal of the role of the various pests affecting them in order that a rational and economical programme of pest control may be drawn up and implemented to ensure that the anticipated high yields are not lost to the pests.

The major insect pests of Hybrid Jowar encountered in the area, the nature of damage and the stage of their appearance are briefly indicated in Table I.

This is the broad pattern of pest-infestation on Hybrid Jowar, which shows that there is a certain time-lag in the appearance of different pests, though some overlapping is not entirely ruled out. Recent trials have shown that a reasonably effective control can be obtained by the application of suitable insecticides in spray, dust or granular forms. It is essential however to time plant protection operations suitably keeping in view the time or stage of appearance of the different pests. With a proper correlation of spraying/dusting schedules with the period of appearance of the respective pests, an effective and economical pest control is possible.

TABLE I

Pest	Nature of damage	Time or stage of appearance
Shootfly: <i>Atherigona indica</i> M. Diptera; Anthomyiidae	Maggots bore into young shoot and cause deadhearts	One week after germination
Flea Beetle: <i>Chaetocnema</i> Sp. Coleoptera; Chrysomelidae	Adult beetles feed on leaves and stems of young seedlings; leaves striped with feeding marks between veins. In case of serious attack tender crop dries up	1-2 weeks
Stem-borers <i>Chilo zonellus</i> Swinh Lepidoptera; Pyralidae and <i>Sesamia inferens</i> W. Lepidoptera; Noctuidae	Caterpillars bore into stem and kill central shoot (deadhearts)	15-50 days (up to flag leaf stage)
Midge: <i>Contarinia andropogonis</i> F. Diptera; Itonididae	Eggs laid in flowers and developing grains hollowed out by pink maggots	60-65 days (Bloom period)
Earhead Bug: <i>Calocoris angustatus</i> Leth Hemiptera; Capsidae	Nymphs and adults feed on grains in 'milk' stage	75-85 days (milk stage)

Grateful thanks are due to Mr. S. V. Rangaswamy for affording facilities for making field observations and to Mr. G. R. K. Murthy for kindly assisting in this work.

S. V. Rangaswamy & Co. D. SESHAGIRI RAO.
Pvt., Ltd.,
75, Kalasipalayam New Extension,
Bangalore-2, March 4, 1966.

DETERMINATION OF TRITHION WITH BISDIAZOTISED ORTHO DIANISIDINE

THE organophosphorus compound S-(p-chlorophenylthiomethyl)-O, O-diethylphosphorodithioate (Trithion) is a broad spectrum insecticide with a long-lasting residual effect and relatively low mammalian toxicity and hence it finds wide application. Trithion may be analysed by total organic phosphorus determination, enzymatic or bioassay method¹; but these methods lack specificity. Among the several paper chromatographic procedures applied for the detection of trithion the reversed phase chromatographic technique of Irudayasamy and Natarajan² using congo red spray is perhaps the simplest. In this system, the R_f value of trithion is 0.43 with the mean deviation of ± 0.01 and the lower limit of detection is $0.5 \mu\text{g}$ of trithion. Ultraviolet spectrophotometrically, trithion, after chromatographic purification, is determined by measuring the absorbance of its iso-octane solution at $260 \text{ m}\mu$.¹ Patchett³ has described a colorimetric method using 2, 6-dibromo-N-chloro-p-quinoneimine for determining trithion residues.

The present note reports a simple colorimetric method using bisdiazotised o-dianisidine for the determination of milligram and sub-milligram quantities of trithion. The method is based upon the hydrolysis of trithion with aqueous potassium hydroxide to p-chlorothiophenol and reaction with bisdiazotised o-dianisidine at a pH between 4.8 and 6.7 buffered with acetate-acetic acid. The resulting yellow colour in carbon tetrachloride phase exhibits an absorption maximum at $375 \text{ m}\mu$. At this wavelength Beer's law is obeyed over the range 10 to 80 ppm and the molecular extinction coefficient is 8580. Solutions of higher concentrations can be diluted suitably until their concentrations are within the optimum range for spectrophotometric measurement.

A study of the absorption characteristics of the colour, the effect of the concentration of the various components and of pH was made. The method is rapid, dependable and is suitable for routine work.

The detailed paper will appear elsewhere.

State Forensic Science Laboratory, A. IRUDAYASAMY.
A. R. NATARAJAN.
Madras-3, January 19, 1966.

1. Gunter, Zweig, *Analytical Methods for Pesticides, Plant Growth Regulators and Food Additives*, Academic Press, New York, 1964, p. 547.
2. Irudayasamy, A. and Natarajan, A. R., *Analyst*, 1965, **90**, 503.
3. Patchett, G. G., *Colorimetric Method for the Determination of R-1303 in Plant Materials*, Stauffer Chemical Company, Richmond, California, 1956.

REVIEWS AND NOTICES OF BOOKS

Methods of Matrix Algebra (Vol. 16: *Mathematics in Science and Engineering—A Series of Monographs and Text-Books*. Edited by R. Bellman). Author: Marshall C. Pease, III. (Academic Press, New York and London), 1965. Pp. xviii + 406. Price \$13.75.

In order to provide the student with a sound working knowledge of the theory, this volume has been developed through the analysis of finitely dimensioned linear systems. The concept of a matrix is developed as a way to describe a linear mapping of a linear vector space into or onto itself. The general theory is developed from the concept of eigenvectors and of chains of generalized eigenvectors, and carried through to the theory of the Jordan canonical form, the theory of functions of a matrix, and the matricant. Special topics covered in this volume include the solution of equations involving singular and rectangular matrices, the use of projectors, the special properties of periodic systems, and the direct product and Kronecker sum. In order to illustrate basic theory, matrix methods are applied to electromagnetic theory, to Sturm-Liouville systems, and to stochastic processes. A brief discussion of the problem of determining stability is included. Deep concepts are used throughout the treatise only in relation to specific applications in physics and engineering. The most significant concept analysed is called by the author, "improper inner product". This concept permits using a known physical conservation law as a metric for the space involved. Thus, the physical properties of the system being studied are built into the mathematics being used.

C. V. R.

Italian Physical Society—Proceedings of the International School of Physics "Enrico Fermi", Varenna, Italy. (Academic Press, New York and London), 1965.

Course 30: Radiation Dosimetry. Edited by F. W. Spiers and G. W. Reed. Pp. 308. Price \$14.00.

The course ran from August 5th to August 17th, 1963, and its Director was F. W. Spiers. It was attended by forty-four persons. The subject-matter of the course was covered in a series of lectures and the following were the speakers and the respective topics dealt with

by them: F. W. Spiers—The Historical Development of Radiation Dosimetry; M. Chiozzotto—Fundamentals of Radiation Absorption Processes; H. H. Rossi—Dose Concepts and Units; A. Allisy—Dosimetrie et Ionisation; J. W. Boag—Ionization Dosimetry at High Intensity; J. W. Boag—High-Pressure Ionization Chambers; H. H. Rossi—Microdosimetry; H. H. Rossi—Neutron and Heavy-Particle Dosimetry; H. H. Rossi—Relative Biological Effectiveness; J. S. Laughlin—Calorimetric Dosimetry: I. Intensity; J. S. Laughlin—Calorimetric Dosimetry: II. Absorbed Dose; J. S. Laughlin—Solid State Dosimetry; N. G. Trott—Scintillation Dosimetry; F. S. Dainton—Chemical Species in Water; F. S. Dainton—Chemical Dosimetry; A. Muller—Electron Spin Resonance Studies of Radicals; E. Casnati—Photographic Dosimetry; N. G. Trott—The Standardization of Radioactive Isotopes; G. W. Reed—Clinical Dosimetry; F. W. Spiers—External Radiation Dosimetry in Bone; F. W. Spiers—Dosimetry of Radioisotopes in Soft Tissues and in Bone; J. S. Laughlin—High-Energy Electron Treatment-Planning Dosimetry; F. W. Spiers—Measurement of Radiation Dose from Environmental Sources; F. W. Spiers—Population Dose from the Medical Use of Ionizing Radiation; L. H. Gray—Radiobiology.

C. V. R.

Random Processes in Nonlinear Control Systems (Vol. 15: *Mathematics in Science and Engineering—A Series of Monographs and Text-Books*. Edited by R. Bellman). Author: A. A. Pervozvanskii. (Academic Press, New York and London), 1965. Pp. xv + 341. Price \$14.00.

This volume contains a discussion of methods of statistical analysis and synthesis for non-linear control systems. Primary consideration is given to systems with inverse coupling. Practical methods for designing both stationary and non-stationary schemes are included. In order to provide the reader with a more precise understanding of non-linear phenomena, the fairly simple methods of approximation, upon which this monograph is based, are accompanied by numerous examples of exact techniques.

Pervozvanskii's new research is incorporated in this systematic review of the most important recent study of the mathematical and physical aspects of non-linear phenomena in the design

of control systems. This concise and authoritative reference is written for control engineers, applied mathematicians, electrical engineers, and graduate engineering students.

The major topics covered in this volume are: methods of analysis and synthesis of non-linear transformations without feedback; statistical methods applicable to non-linear systems with feedback; techniques for studying non-stationary operation in non-linear closed systems, and classification of extremal systems. C. V. R.

Solid State Physics: Advances in Research and Applications (Vol. 17). Edited by F. Seitz and David Turnbull. (Academic Press, New York and London), 1965. Pp. xvii + 379. Price \$ 14.00.

Volume 17 of this well-known series contains the following four contributions by eminent authors in this field: 1. The Effects of High Pressure on the Electronic Structure of Solids, by H. G. Drickamer; 2. Electron Spin Resonance of Magnetic Ions in Complex Oxides. Review of ESR Results in Rutile, Perovskites, Spinel, and Garnet Structures, by W. Low and E. L. Offenbacher; 3. Ultrasonic Effects in Semiconductors, by Norman G. Einspruch; 4. Quantum Theory of Galvanomagnetic Effect at Extremely Strong Magnetic Fields, by Ryogo Kubo, Satoru J. Miyake, and Natsuki Hashitsume. C. V. R.

Metallurgical Society Conferences (Vol. 26). *Mechanical Working of Steel 2*. Edited by T. G. Bradbury. (Gordon and Breach, Science Publishers, 150, Fifth Avenue, New York 11, N.Y.), 1965. Pp. ix + 542. Price: Paper \$ 14.50; Cloth \$ 27.50.

This volume represents the Proceedings of the Sixth Technical Conference sponsored by the Mechanical Working and Steel Processing Committee of the Iron and Steel Division, The Metallurgical Society and the Chicago Section, American Institute of Mining, Metallurgical, and Petroleum Engineers and held at Chicago, Illinois, from January 30 to 31, 1964.

The contents of this book are: **BAR AND SEMIFINISHED PRODUCTS**—Morphological Effects of Some Nonmetallics in Free Machining Steels; The Role of Oxygen in Free Cutting Steels; Measurement of Machining Performance of Steels; Statistical Study on the Effect of Chemical Composition on the Machinability of 12 L 14; Factors Affecting the Machinability of Low-Carbon Free Machining Steels; Metallurgical Factors Affecting the Machining of a Free-

Machining Stainless Steel; An Investigation of the Machinability of Elevated Temperature Drawn Alloy Steel Bar Stock; Manufacturers' Evaluation of Machinability; Annealing and Processing for Machinability; Variable Machinability—Some Production and Economic Implications; Tool Evaluation; A Review of the Alternate Methods of Metal Removal; Current Research on Rod and Bar Rolling at B.I.S.R.A. **FLAT ROLLED PRODUCTS**—Recrystallization Behaviour of Cold Rolled Mild Steel; Effect of the Rolling Load on the Microstructure of Low Carbon Sheet Steel; Aging of Flat-Rolled Steel Products as Investigated by Electron Microscopy; Strain Aging, Quench Aging and Magnetic Aging in Low Carbon Steel; Study of the Origin of Ridges Occurring during Cold Rolling; Panel Discussion: Control of Flatness in Coils. **PIPE AND TUBULAR PRODUCTS**—Recent Developments in the Evaluation of Fracture Toughness of Line Pipe; The Continuous Casting Process; Seamless Pipe and Tubing from Continuously Cast Steel Billets; Some Aspects of Electricweld Pipe Production; Mobile Pipe. C. V. R.

Computers in Biomedical Research (Vol. 1). Edited by R. W. Stacy and B. D. Waxman. (Academic Press, New York and London), 1965. Pp. xxii + 562. Price \$ 20.00.

In the space of a few years, biomedical computing and automatic data processing have become a significant part of the biomedical scientific effort; the development of these techniques and approaches is new to the medical sciences and their use constitutes a major contribution in this century. The aim of this treatise has been to provide realistic information on the present state of this new field and to furnish guidelines for those who will enter the field in the near future.

Included in this volume are discussions on computer technology, broad concepts of application to biomedical problems, descriptions of specific research programs, a projection of things to come, and a general discussion of the many aspects of biomedical computing.

This work will be of interest to a wide range of scientists, for there are few fields which cannot benefit from application of one or more of the methods described herein. It will be found to be of great use by clinicians and medical scientists, pure biologists, physical scientists, and specialists in computer science.

C. V. R.

Methods of Animal Experimentation (Vol. 1). Edited by William I. Gay. (Academic Press, New York and London), 1965. Pp. xv + 382. Price \$13.50.

This book provides information on the most common methods for using animals as tools in the search for new biological knowledge. The descriptions of both fundamental and well developed techniques of animal experimentation in various research fields should be useful to graduate students and experienced scientists who must consider variations in research approaches.

The titles of the chapters and their respective authors contained in this volume are as follows: Introduction, by T. B. Clarkson; Collection and Withdrawal of Body Fluids and Infusion Techniques, by Alvin F. Moreland; Anesthesia and Sedation, by Albert Schaffer; Care of Animals during Surgical Experiments, by Norman Bleicher; Radiography, by William D. Carlson; Methods of Euthanasia and Disposal of Laboratory Animals, by Dietrich C. Smith; Methods in Parasitic Infections: Outline of General Principles, by Ira Singer; Methods in Germfree Animal Research, by Walter L. Newton; Aerosol Challenge of Animals, by Joseph V. Jemski and G. Briggs Phillips; Principles in Drug Administration, by Geoffrey Woodard.

This book will serve as a source of information for the scientist administrator who is frequently confronted with different proposed approaches to biological research projects utilizing animals.

C. V. R.

Methods in Computational Physics—Advances in Research and Applications (Vol. 4): *Applications in Hydrodynamics*. Edited by B. Alder, S. Fernbach and M. Rotenberg. (Academic Press, New York and London), 1965. Pp. xi + 385. Price \$14.00.

In recent years, large digital computers have become essential tools in solving a great variety of hydrodynamics problems.

The present volume illustrates the power and versatility of these computers through reports of their varied applications in the field. Included are studies of atmospheric circulation, ocean circulation, shocks in rarefied media, molecular flow in a gas, molecular dynamics in a fluid, stability of boundary layers, propeller design, stellar evolution, and seismology.

C. V. R.

Transistor Circuits (2nd Edition). By K. W. Cattermole. (Gordon and Breach, Science Publishers, 150, Fifth Avenue, New York-11, N.Y.), 1965. Pp. 488. Price \$14.50.

The transistor is an electrical amplifying and switching device of such versatility that its properties should be known to technical workers in radio, telecommunications, computing, and many other fields. This book gives an introductory account of the principal functions and circuit arrangements in which transistors can be used, together with brief sketches of the devices themselves and of certain major applications. Its ideal reader is primarily interested in some field of usage; he is familiar with thermionic valves and electric circuits in general, but need have no more physics and mathematics than is normally consequent on that knowledge.

In this second edition, the changes made are those necessitated by the continuing progress in transistor design, manufacture and application. The most important device development is the drift transistor. Of some interest also are the newer negative-resistance devices: tunnel, P-N-P-N and similar structures are described in the present edition and necessary changes made to accommodate them in the text.

C. V. R.

The Molecular Designing of Materials and Devices. Edited by Arthur R. Von Hippel. (The M.I.T. Press, Cambridge, Mass, 02142), 1965. Pp. xi + 272. Price \$25.00.

"Nature designs everything from atoms; hence, we should be able to create any feasible kind of material and device with foresight, if we understood the Periodic System in all its implications. Yet—like weather forecasters—we find ourselves still members of the gambling profession." This was the tenor of the third summer session on modern materials research sponsored by the Laboratory for Insulation Research at the Massachusetts Institute of Technology in 1963. Its program—organized by Arthur R. von Hippel, Institute Professor and one of the pioneers of modern materials research—ranged from the electronic structure of atoms and molecules to the design patterns and operating mechanisms of living systems. The participants came from a gamut of professions and the course seemed threatened by a confusion of tongues; instead, the two weeks of learning and debating proved so full of interest and enjoyment that the majority of the lecturers voted for a joint publication of their contribu-

tions. Thus this volume on *The Molecular Designing of Materials and Devices* joins its three predecessors (*Dielectrics and Waves*, *Dielectric Materials and Applications*, and *Molecular Science and Molecular Engineering*), already established as classics in their fields.

This book advances its theme in three stages : from the architecture of materials to the properties produced by structures and compositions and to the devices employing such properties with increasing sophistication. Since this vast panorama is conjured by twenty-five experts with highly individual outlooks, an extensive survey traces the problems and thoughts that connect chapter to chapter. The text is supported by a great number of illustrations, and a comprehensive index gives additional unity and long-range usefulness to the presentation.

C. V. R.

The Earth's Shape and Gravity. By G. D. Garland. (Pergamon Press, Headington Hill Hall, Oxford). Pp. 183. Price 17 sh. 6 d. net.

One of the well-known methods for the determination of the shape of the earth is based on the variations of the acceleration due to gravity over the surface of the earth. New facilities and new techniques for measurements of gravity anomalies have come into practice. The use of satellites has enabled accurate data to be obtained, and combined with the use of high speed computers to interpret the results, the method has become a valuable tool to investigate the interior of the earth also.

This book gives in outline the physical principles involved in the measurement and interpretation of gravitational anomalies, and points out their applications to problems connected with the interior of the earth, the structure of the earth's crust, and geophysical prospecting. It can be recommended as a suitable introductory text-book on the subject to students of geophysics with a background knowledge of mathematics and physics.

A. S. G.

Statics of Deformable Solids. By R. L. Bisplinghoff, J. W. Mar and T. H. H. Pian. Addison-Wesley Publishing Co. Inc., Reading, Massachusetts, U.S.A.), 1965, Pp. 322. Price \$ 11.50.

Based on notes prepared to aid the teaching of solid mechanics to aeronautical engineering students at the Massachusetts Institute of Technology, the authors have in this book developed the subject in such a way as to

retain the student's interest. The fundamental principles have been effectively introduced with a minimum of detail. The treatment includes analyses of strain and stress, elasticity, plastic behaviour of solids, and energy principles in solid continuum. A background knowledge of the use of vectors and tensors is assumed on the part of the reader. A number of illustrative problems are included in each chapter.

A. S. G.

The Control of Fertility. By Gregory Pincus, (Academic Press, New York and London), 1965. Pp. 360. \$ 9.00.

The bleak demographic future of the world with an expected doubling of the present population before the end of the second millennium, has created an awareness among people of the need for controlling their own proliferation in number. The success of oral contraceptives and the availability of effective types of steroid compounds for this purpose have stimulated experimental studies of fertility control. Literature in the form of published papers is increasing, but the book under review is perhaps the first of its kind that has brought between two covers the sum of present knowledge on the specific biological problem of the experimental control of fertility in higher animals and humans. Professor Gregory Pincus is well known for his sustained and deep studies in this area of research. The results of these studies, some of them so far not published, are embodied in this book. It describes the reproduction processes and their vulnerabilities in mammals, focuses attention on the nervous and hormonal factors controlling spermatogenesis, oogenesis, ovulation, and production of sex hormones in animals and human subjects.

This authoritative publication containing results of animal and clinical investigations on the control of fertility will be invaluable to biologists, biochemists, physiologists, doctors and clinicians who are concerned with researches in this area of study.

A. S. G.

Announcements

Award of Research Degrees

Andhra University has awarded the Ph.D. degree in Physics to Sri. K. Madhusudhana Rao ; Ph.D. degree in Nuclear Physics to Sri. R. V. Ramamohan ; Ph.D. degree in Zoology to Sri. N. Solomon Raju.

Sri. Venkateswara University has awarded the Ph.D. degree in Botany to Sri. P. Venkata Raju ; Ph.D. degree in Zoology to Smt. C. Vijayalakshmi.

The M. S. University of Baroda has awarded the Ph.D. degree in Physics to Shri A. Krishna Menon, Shri Bhupendra Sureshchandra Shah and Shri Syed Ziaur Rehman Hashmi; Ph.D. degree in Chemistry to Shri Rajendraprasad Hariprasad Mehta; Ph.D. degree in Zoology to Kumari Freny Dinshaw Bokdawala and Kumari Niloufer Jamshed Chinoy.

The Karnatak University has awarded the Ph.D. degree in Physics to Shri V. V. Itagi and Kumari Sharada Hegde.

Summer School and Symposium on Electron Microscopy

The Central Instruments and Services Laboratory, Indian Institute of Science, Bangalore, will hold a Summer School and Symposium on Electron Microscopy from May 16-27, 1966. The School is open to scientists actively engaged in Electron Microscopy and its applications.

Further enquiries to be addressed to: Dr. M. Ramakrishna Rao, Central Instruments and Services Laboratory, Indian Institute of Science, Bangalore-12.

Diapause in Fishes

S. M. Das and Y. R. Malhotra, P. G. Department of Zoology, Jammu and Kashmir University, Srinagar-3, write:

In our investigations for the last four years (1961-65) it has been observed that the ovaries of many cold water fishes enter a 'diapause' in which the ovarian activity is arrested at a stage either before the onset of vitellogenesis (i.e. stage I, in *Botia* and *Crossochilus*) or after the completion of vitellogenesis (i.e. after stage IV, in *Schizothorax* and *Oreinus*).

In the first case it is the scarcity of food and low environmental temperature which appears to arrest the ovarian activity from October to April, while in the second case it is only the low environmental temperature from December to April which appears to act through the hypophysial system.

Chemical Methods of Weed Control in Upland Paddy Fields

G. B. Manna and M. S. Chaudhry of the Central Rice Research Institute, Cuttack (Orissa), write: Trials carried out at this Institute indicate that chemical herbicides belonging to M.C.P.A. group used at an optimum dose of 2 lb. acid equivalent in 100 gallons of water, and sprayed about 4 weeks after planting

could efficiently control weeds like *Hydrolea-zeylanica*, *Courtoisia cyperodis*, *Fimbristylis misiaea*, *Anmania pentendra* and *Ludwigia purvisflora*, etc., which mostly predominate in the transplanted upland rice fields. Members of *Gramineae* family are not affected either by 2, 4-D or M.C.P.A. A majority of *Gramineaceous* weeds could, however, be suppressed by the use of Stam F_{34} (DPA).

Results of a field trial from the yield of crop indicate that a mixture of Phenoxylen-30 (M.C.P.A.) and Stam F_{34} (DPA) is more effective than either of these applied individually. This mixture could be used as an alternative to hand-weeding.

Books Received

The Kjeldahl Method for Organic Nitrogen. By R. B. Bradstreet. (Academic Press, New York), 1965. Pp. viii + 239. Price \$ 9.50.

Advances in Agronomy (Vol. 17). Edited by A. G. Norman. (Academic Press, New York), 1965. Pp. xi + 386. Price \$ 14.00.

Handbook of Preparative Inorganic Chemistry (2nd Edition). By G. Brauer. (Academic Press, New York), 1965. Pp. xxiv + 1003-1859. Price \$ 32.00.

Earth's Shape and Gravity. By G. D. Garland. (Pergamon Press, Headington Hill Hall, Oxford), 1965. Pp. vii + 183. Price 17 sh. 6 d.

The Human Eye and the Sun: Hot and Cold Light. By S. I. Vavilov. (Pergamon Press, Headington Hill Hall, Oxford), 1965. Pp. xi + 156. Price 15 sh.

Women and the Scientific Professions. Edited by J. A. Mattfeld and C. G. Van Aken. (The M.I.T. Press, 50 Ames St., E. 19 Room 741, Cambridge, Mass. 02142), 1965. Pp. xvii + 250. Price \$ 6.95.

Scientific Societies in the United States (3rd Edition). By R. S. Bates. (The M.I.T. Press, Cambridge, Mass. 02142), 1965. Pp. 326. Price \$ 8.75.

The Molecular Designing of Materials and Devices. Edited by A. R. von Hippel. (The M.I.T. Press, Cambridge, Mass. 02142), 1965. Pp. xi + 272. Price \$ 25.00.

Documents on Modern Physics—Dynamical Theory of Groups and Fields. By B. S. Dewitt. (The M.I.T. Press, Cambridge, Mass. 02142), 1965. Pp. xv + 248. Paper bound: \$ 2.95; Cloth: \$ 5.95.

Underwater Explosions. By R. H. Cole. (Dover Publications, New York), 1965. Pp. ix + 437. Price \$ 2.75.

THE NEW PHYSIOLOGY OF VISION

Chapter XL. The Colours of Iolite

SIR C. V. RAMAN

AN attractive display of colour by a mineral serves to gain for it a position of esteem as a gemstone. The colour is determined, in the first place, by the absorption of light in its passage through the solid. But this is only one aspect of the matter. Scarcely less important is the role played by the physiology of vision. For, the perceived colour of a gemstone results from the synthesis by the visual mechanism of the different spectral components of the light emerging from its interior. This field of investigation was traversed in an earlier chapter, but we return to it to consider the particularly interesting case of iolite.

The name iolite is derived from the Greek word for violet and is indicative of the colour of the gemstone. It is found in gem-gravels as water-worn pebbles, one of the principal sources being Ceylon. Iolite is also known by another name as cordierite, a mineral which is found associated with gneisses and schists and exhibits the phenomenon of pleochroism in a very striking fashion. It is with cordierite that Sir David Brewster discovered the optical effect known as "Brewster's brushes" which we shall refer to later in this paper and which stands in close relationship to the colour and pleochroism of biaxial crystals.

Cordierite is found in various parts of South India and especially in the Coimbatore District. Its optical properties were made the subject of a penetrating study by Dr. S. Pancharatnam and the memoirs describing his results were illustrated by a striking and beautiful series of photographs. These will be found in the *Proceedings of the Indian Academy of Sciences*, Vol. XLII, 1955, as Plates V, VI and VII and in Vol. XLV, 1957, as Plates I and II. We shall have occasion later to refer to Dr. Pancharatnam's publications.

The Pleochroism of Iolite.—Though much of the material from Coimbatore is in the form of irregular lumps, some specimens were available which were the result of the cleavages or partings of crystalline blocks. These specimens were ground to the form of plates and then polished, thereby enabling the colour and other optical characters of the crystal to be critically examined. The plates, each a few millimetres thick, prepared in this manner fell into two distinct groups. The first group shows a

brownish-yellow colour by transmitted light. Viewed through a polaroid, this light is found to be completely polarised; it comes through freely in one setting of the polaroid and is extinguished in a perpendicular setting. Viewed edgewise, plates of this group allow light of a brownish-yellow colour to filter through in one direction, but are perfectly opaque in a perpendicular direction.

The second group of plates shows a wholly different behaviour. The light transmitted by them exhibits a blue colour, the thicker specimens showing a deeper colour as is to be expected. Viewed normally through a polaroid, the plates of this group show a noticeable variation in the colour and intensity of the transmitted light as the polaroid is rotated. The transmitted light appears brighter and less saturated in colour in one setting of the polaroid and less bright and of a deeper blue in a perpendicular setting. The edges of one such plate were smoothed and polished, so that it could be held edgewise and its optical behaviour examined. Despite the rather long path which the light has then to traverse, it comes through freely and allows distant objects to be seen quite distinctly. The colour of the light thus perceived is reddish-brown. Examination through a polaroid shows it to be completely polarised.

Observations have also been made with a small piece which was cut and polished to the shape of an approximately cubical block of about four millimetres edge-length. The light transmitted by the block in the three mutually perpendicular directions showed three different colours. One was a very pale yellow, the second a deep blue and the third a light blue. The pale yellow light emerging through one pair of faces when viewed through a polaroid is found to be completely extinguished in one setting of the polaroid, and comes through freely in the perpendicular setting. The light of a deep blue colour coming through the second pair of faces was found to be much weakened but not totally extinguished in a particular setting of the polaroid, but comes through with little noticeable change in the perpendicular setting. The light of a pale blue colour coming through the third pair of faces behaves differently. It is not extinguished in any setting

would be expected from a benzylic 4-glycoside or ether linkage. Hence the glycosidic linkage should be at 3, and there is no ether function in 4-position.

The structure of the oligosaccharide was revealed by mild hydrolytic treatment when the different sugars showed up at different time intervals as seen on filter-paper chromatograms. Glucose was the first to appear showing that it is at the end of the chain. It was followed by rhamnose. Using higher acid concentration arabinose was obtained and finally xylose showing that the aglycone is linked first to xylose.

Fraction B_2 , when converted into acetate and examined by T.L.C., revealed the presence of four distinct entities and a good amount of polymeric material. Out of these, three agreed with the glycosides of B_1 , but the fourth had a much greater R_f . Extraction of it with ether and examination by paper chromatography showed this to be (–) epicatechin.

Fraction A was brown and very hygroscopic. T.L.C. of its acetate showed besides the three glycosides present in B_1 , another slow moving substance in substantial amount which was separated by column chromatography on silica gel. It was a white amorphous powder, m.p. 225–35°, $\lambda_{\text{max}}^{\text{EtOH}}$ 280 m μ . ($E_{1\%}^{1\text{cm}}$ 73.3), $[\alpha]_D^{20} + 92.8^\circ$ (Found: C, 58.5; H, 4.7; $C_{27}H_{26}O_{13}$ requires C, 58.1; H, 4.6%). It gave only cyanidin chloride on hydrolysis and did not contain any sugar. The above data are collected in Table I.

The compounds now reported are definitely glycosidic; the aglycone in all three glycosides is leucocyanidin either monomeric or in combination with very similar skeleton and cyanidin chloride is the only conversion product. Moreover since tetramethyl cyanidin chloride is obtained from the methyl ether of the glycoside mixture only the 3- or 4-position is left for the sugar linkage. The final choice is position 3, not only because hydrogenolysis of the sugar group was not possible but also because in the corresponding natural anthocyanins 3 is the most favoured position for glycoside formation.

The remarkable fact about the three glycosides which are named as Bassianin a, b and c is that

TABLE I

Solvent	Fraction name	Compound	Isolated as
95% Ethanol	A	Leucocyanidin (Monomer or Polymer) + Glycosides (not separated)	Acetate
50% Ethanol	B_1	Glycoside (a) Glycoside (b) Glycoside (c) + Polymers	Acetate Acetate Acetate
	B_2	Glycoside mixture (not separated) + (–) Epicatechin	(–) Epicatechin

though they all contain leucocyanidin and the same oligosaccharide unit (R-O-Xylose-O-Arabinose-O-Rhamnose-O-Glucose), they give different analytical values which do not fit in with those calculated for the monomer. It would appear that glycosides of *Bassia butyracea* are formed from polymeric aglycones recently studied by Geissman and Dittmar,² Freudenberg and Weinges³ and Moorthy and Seshadri.⁴ The formation of (–) epicatechin on mild hydrolysis of the glycoside mixture lends support to this. The occurrence of free (–) epicatechin and leucocyanidin along with these glycosides also suggests that the aglycone polymer is formed from these two flavans. The difference between the glycosides is thus only in the degree of polymerisation of the aglycone part. The intensity of absorption in the ultra-violet (the ratio $E_{\text{max}}/E_{\text{min}}$, increases from acetate a to acetate c indicating that the degree of polymerisation increases in the same order.

Details of this work will be published elsewhere.

1. *Methods in Carbohydrate Chemistry*, Ed. L. Whistler, and M. L. Wolfrom, Academic Press, New York and London, 1962, 2, 215.
2. Geissman, T. A. and Dittmar, H. F. K., *Phytochem.*, 1965, p. 359.
3. Freudenberg, K. and Weinges, K., *Chemical Communications*, 1965, 11, 220.
4. Krishnamoorthy, V. and Seshadri, T. R., *Tetrahedron* (in press).

AN HYPOTHESIS CONCERNING THE EVOLUTION OF THE LUNAR SURFACE

D. M. MILLER

17, Medway Crescent, London, Ont., Canada

THE most widely held theory concerning the solar system is that the various bodies composing it were formed during the contraction of a large revolving disc-shaped cloud of dust and gas. Turbulence within this cloud is considered to have resulted in the formation of a number of regions of high concentration to which further matter was drawn by gravitational force. Such regions gradually developed into the sun and its satellites during which time virtually all the original materials became associated with one or other of these bodies. Urey¹ introduced the concept of "planetesimals", loose aggregates of dust held together initially by partially-frozen gases, which he suggested collided to form the protoplanets. These in turn acted as nuclei to which more material was attracted by gravitational force.

inter-planetary material, however, eventually would have decreased the infall, causing the collision rate to rise to a maximum and then drop in a roughly exponential fashion as in Fig. 1 A. Heat released by each collision would have increased the temperature of the entire planet. This would have been balanced to some degree by radiation, so that the temperature of the planet's surface (but not of its interior) probably followed a similar course to that of the collision frequency shown in Fig. 1 A. Eventually as the collision frequency and temperature dropped, however, a point must have been reached at which the surface solidified to form the lunar crust. It is the contention here that at this time (t_c , Fig. 1) the amount of inter-planetary material, while much less than its initial value, was still many times what it is

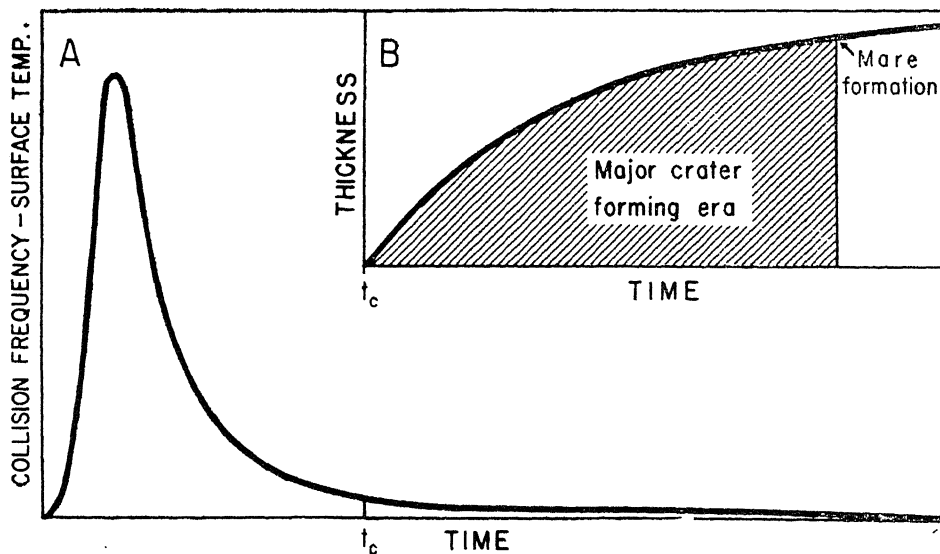


FIG. 1

In accordance with this theory we might expect that the collisions of dust and planetesimals with a protoplanet must have been few initially but must have increased in frequency and energy as the protoplanet increased in size and gravitational influence. Depletion of the

today. Thus subsequent infall would have covered the bedrock with a layer of dust whose present average thickness is probably of the order of a kilometer. The various features visible on the moon's surface today might then simply be distortions of this layer caused by

these probably struck the moon from different angles before finally evaporating. Thus a few smaller maria would have been formed in regions remote from the main collision area. The moon appears to have been sufficiently plastic at this stage to have yielded under the tremendous onslaught of the mare-forming bodies producing depressions in, and cracking of, the moon's crust. Subsidence of the dust into these cracks could have produced the rilles found mostly in and around the maria.

Gold⁷ has also suggested that the maria consist of a thick layer of dust. He considers, however, that the dust originated from erosion of rocks in the uplands and that it then became fluidized, flowing down into the depressed areas like water, to form the maria. This theory has been seriously challenged as a result of the recent Luna 9 photographs which provided a close-up of the moon's surface.⁸ From these it is quite obvious that no loose dust is present in the area surveyed by the cameras.⁹ According to the above theory this would simply indicate that during the eons since deposition of the dust layer and formation of the maria, constant bombardment by micrometeorites and solar particles has resulted in a sintering of the dust surface into a hard rough crust. This crust, which may be centimeters or even meters thick probably covers the entire surface of the moon except those areas recently subjected to bombardments of sufficient energy to shatter the crust and displace the underlying dust.

It has been pointed out by several workers that the earth is likely to have been in collision with a number of comets during its history. This would apply to all the terrestrial planets, all of which must have received at least some of their atmospheric gases and free water by this means. The amount of free water on the earth, however, appears to be so much greater than on either Venus or Mars that some special circumstance must have arisen to provide water to the earth alone. The collision of the earth with a swarm of comets or volatile planetesimals such as proposed above could have formed ocean basins, added the necessary water and furthermore would have provided large quantities of carbon compounds, which as Oro has suggested, contributed to the initial phases of life. In fact, such an event may well have been an essential prerequisite to the origin of life on the earth.

1. Urey, H. C., *The Planets*, Oxford University Press, London, 1952.
2. Baldwin, R. B., *The Measure of the Moon*, University of Chicago Press, Chicago, 1963.
3. Southworth, R. B., *Ann. New York Acad. Sci.*, 1964, **119**, 54.
4. Shoemaker, E. M. and Hackman, R. J., Quoted in Ref. 2.
5. Markov, A. V., *The Moon*, Ed. A. V. Markov, University of Chicago Press, Chicago, 1962.
6. Whipple, F. L., *Astrophys. J.*, 1950, **3**, 375.
7. Gold, T., *M.N.*, 1955, p. 585.
8. Davies, J. G., Lovell, B., Pritchard, R. S. and Smith, F. G., *Nature*, 1966, **209**, 848.
9. Fielder, G., Wilson, L. and Guest, J. E., *Ibid.*, 1966, **209**, 851.

CARNEGIE INSTITUTION OF WASHINGTON—YEAR BOOK 64 *

THE Year Book 64 of the Carnegie Institution of Washington contains reports on current research from all departments of the Institution for the year July 1, 1964 to June 30, 1965.

Spectroscopic observations of quasi stellar sources have become of special importance to cosmology, and the 200-inch Hale telescope combined with the Schmidt camera has been providing unique opportunities in this field to workers of the Mount Wilson and Palomar Observatories. During the year spectacular red-shifts for five quasi stellar sources have been measured. The most distant of the five, 3C9, showed the Lyman alpha line shifted from its normal position of 1216 Å to 3660 Å, giving a red-shift $\Delta \lambda/\lambda_0 = 2.012$.

The Geophysical Laboratory reports in detail

the progress of work on processes of ore formation, fatty acid residues in rocks by gas chromatographic techniques, petrographical applications of discriminant function analysis, basalt-eclogite transformation, etc. In the Plant-Biology Department fundamental work in photosynthesis and function and composition of pigment complexes in plants continued to engage the attention of workers. In the Cytogenetics Laboratory researches have been continued on problems of fine structure and molecular organization of chromosomes in higher plants and animals.

* *Carnegie Institution of Washington Year Book 64*. Pages xii/64/596. Selling Price \$1.50, clothbound. Carnegie Institution, 1530 P Street, North-West Washington, D.C.

LETTERS TO THE EDITOR

DIPOLE MOMENTS OF CERTAIN CHOLESTERYL COMPOUNDS

MANY investigations have been carried out on the dielectric properties of liquid crystalline substances in the mesophases. Of these the nematic type of mesophase has been studied extensively and a review of the work has been given by Grey¹ and Brown and Shaw.² As a part of systematic investigation on the dielectric properties of liquid crystals of cholesteric type the dipole moments of eight compounds for which the data had not been reported previously have been determined and reported here. These are six cholesteric esters formate, acetate, propionate, *n*-butyrate, *n*-valerate, benzoate and cholesteryl chloride and bromide.

The dielectric constant of solutions of these in two non-polar solvents benzene and carbon tetrachloride were determined using Franklin oscillator wave-meter combination at 1 Mc./sec. described by Le Fevre, Ross and Smyth.³ The moment values were computed using Guggenheim's⁴ modified equation for orientation polarisation.

$$P_0 = \frac{3}{(\epsilon_1 + 2)^2} \frac{M}{d_1} \Delta$$

the symbols having their usual significance.

The values of the dipole moments in the two solvents are given in Table I.

TABLE I
Dipole moments of cholesteryl compounds

Compound	μ in Debye Units	
	Benzene	Carbon Tetrachloride
Formate	2.55	3.26
Acetate	1.90	2.09
Propionate	2.03	2.36
Butyrate	1.91	2.19
<i>n</i> -Valerate	2.48	3.30
Benzoate	1.85	2.08
Chloride	4.40	3.45
Bromide	2.40	2.86

We are grateful to Prof. K. R. Rao for his encouragement and to the Council of Scientific and Industrial Research for financial assistance.

Microwave Lab., C. V. S. S. V. GOPALAKRISHNA.
Physics Dept., C. HARANADH.
Andhra Uni., C. R. K. MURTY.
Waltair, February 19, 1966.

1. Grey, G. W., *Molecular Structure and Properties of Liquid Crystals*, Academic Press Inc., New York, 1962.
2. Glenn, H. Brown and Wilfrid, G. Shaw, *Chem. Reviews*, 1957, **57**, 1049.
3. Le Fevre, R., Ross and Smyth, *J. Chem. Soc.*, 1950, p. 276.
4. Guggenheim, E. A., *Trans. Farad. Soc.*, 1951, **47**, 573.

RELAXATION TIMES OF MIXTURES OF BENZALDEHYDES IN BENZENE

ACCORDING to Schallamach,¹ Bauer² and Magat,³ only a single relaxation time is involved for a microscopically homogeneous liquid, even if it is a mixture. Following this suggestion the authors have determined the relaxation times of two mixtures namely *o*-chlorobenzaldehyde + *m*-chlorobenzaldehyde and benzaldehyde + *m*-chlorobenzaldehyde in dilute solutions of benzene at 3 cm. using the concentration variation method of Gopala Krishna.⁴ The technique of Roberts and von Hippel^{5,6} described earlier was adopted for determining the dielectric constants (ϵ') and dielectric loss factors (ϵ'') of solutions. As the wavelengths of maximum absorption for the pairs of polar molecules selected lie very near to each other, a single relaxation time may be expected showing the superimposed effect of the pair.

Five solutions of increasing concentration were made by accurately mixing equal volumes of the two components in 10 ml. of benzene. The relaxation times obtained are given in Table I.

TABLE I
Relaxation times of mixtures of benzaldehydes
($f=9567$ Mc./sec., Temperature = 27° C.)

Mixture	τ in sec.	
	$\tau_{\text{mix}} \times 10^{12}$	$\tau_{\text{comp}} \times 10^{12}$
1 <i>o</i> -Chlorobenzaldehyde + <i>m</i> -chlorobenzaldehyde	11.3	11.0 12.5
2 Benzaldehyde + <i>m</i> -chlorobenzaldehyde	11.5	10.6 12.5

been prepared in actual production batches corresponding to an enrichment of 1,000–1,600 (Table II). For regular production, crystalline K_2CrO_4 was irradiated in CIR at neutron fluxes of $(50-100) \times 10^{11}$ n/cm.²/sec. for one week. The irradiated sample was dissolved in the minimum volume of 0.1 N NaOH and kept overnight. The enriched trivalent chromium-51 precipitate was centrifuged off, washed free from any adsorbed chromate, and then oxidised to chromate.

TABLE I

Direct precipitation of chromium (III) from potassium chromate

S. No.	Concentration of Cr (III) in ppm.	Concentration of alkali used	Time of settling (hours)	Percentage recovery of Cr (III) %	Ratio of $Cr^{51}O_4$ co-precipitated to total Cr-51 in the precipitate
1	2	3	4	5	6
1	0.3	1 M NH_4OH	1	3	Not estimated
2	0.3	"	16	5	"
3	1.8	"	16	25	"
4	1.15	"	16	30	0.2
5	25	1 N NaOH	16	44	0.3
6	25	1	16	24	0.1
7	30	0.03	16	60	0.6

TABLE II

Preparation of chromium-51 by direct precipitation

S. No.	Total K_2CrO_4 irradiated (g.)	Neutron flux and duration	Percentage of high specific activity $Cr-51$	Specific activity mc./mg.	Enrichment factor
1	12	60×10^{11} n/cm. ² /sec. 6 days	10	180	1200
2	36	50×10^{11} n/cm. ² /sec. 6 days	8	200	1600
3	12	90×10^{11} n/cm. ² /sec. 6 days	11	235	1000

(g) Precipitation of the enriched Cr^{51} (III) activity on a column of chromatographic grade alumina has been found to give almost quantitative recovery of the Cr^{51} (III) activity and products of specific activity 100–500 curies per gram have been obtained corresponding to an enrichment of (1,500–2,500) for different irradiation conditions. The optimum irradiation conditions have been found to be 2–6 days at neutron fluxes varying from $(50-150) \times 10^{11}$ n/cm.²/sec. and the yield of high specific activity

$Cr-51$ (specific activity greater than 100 curies per gram) has been found to be 3–5 mc. per gram of the irradiated K_2CrO_4 .

(h) Chromium acetyl acetonate was irradiated in the CIR for 12 hours to 7 days in batches of 2 gm. at neutron fluxes ranging from $(20-80) \times 10^{11}$ n/cm.²/sec., and the high specific activity Cr^{51} extracted out by equilibrating a benzene solution of the acetyl acetonate with dilute HCl. Product of specific activity 3–10 mc./mg. were obtained corresponding to an enrichment factor of 20–60 and a yield of 20–40%.

CONCLUSION

Chromium-51 of high specific activity and purity can be prepared by recoil enrichment, using pure crystalline potassium chromate as the target. An optimum irradiation of 3–6 days at a neutron flux of $(50-150) \times 10^{11}$ n/cm.²/sec. in the self-serve position in the CIR, followed by suitable chemical separation, gives a product of high specific activity (100 curies per gram), suitable for medical use. Cation exchange separation, direct precipitation, and precipitation on a column of alumina can be used for the chemical separation of the enriched chromium-51 activity. However, in the first two methods, a slight dilution of the specific activity of the chromium-51 might take place due to reduction of the chromate by the cation exchanger, or the co-precipitation or adsorption of traces of chromate on the chromic hydroxide. Chromium in the concentration level of 2–50 ppm coagulates and settles down as the hydroxide from dilute alkaline solutions of chromate over a period of 12 to 16 hours.

Isotope Division,
Atomic Energy

R. S. MANI.

S. Y. CHOWDHARY.

Establishment,
Trombay, February 18, 1966.

1. *The Dispensatory of the United States of America*, J. B. Lippincott Company, Montreal, 1960. p. 1824.
2. Waldman, T. A., *The Lancet*, July 15, 1961, p. 121.
3. Vyas, G. N. (Private Communication).
4. Harbottle, G. and Maddock, A. G. *J. Chem. Phys.*, 1953, **21**, 1686.
5. —, *Ibid.*, 1954, **22**, 1083.
6. Kahn, M., Freedman, A. J. and Bryant, E. A., *AECR* — 2329, 1953.
7. Fernelius, C. and Blanch, J. E., *Inorganic Synthesis*, Ed. by T. Moeller, McGraw-Hill Book Co. Inc., New York, 1957, **5**, 130.
8. Mani, R. S., *Int. J. of Appl. Radiation and Isotopes*, 1963, **14**, 327.

ADDUCTS OF LANTHANON CHLORIDES
WITH DIMETHYL SULPHOXIDE

DIMETHYL sulphoxide (DMSO) is known to form a number of co-ordination complexes with transition and non-transition metal compounds.¹⁻⁴ We report here the isolation and characterisation of seven new complexes of DMSO with rare earth and yttrium chlorides. They were prepared by dissolving the hydrated chlorides in a slight excess of DMSO and pumping off the excess ligand until a dry solid was obtained, which was then washed with dry benzene and dried over P_2O_5 under reduced pressure. Analysis of the metal halogen and DMSO parts of the complexes conform to the formula $Ln(DMSO)_n Cl_3$ where $Ln = La, Ce, Pr, Nd, Sm$ and $Gd, n = 4$; and $Ln = Y, n = 3$. The colours of the complexes were similar to those of the parent halides except in the case of cerium complex which was pale yellow. The complexes were insoluble in non-polar solvents and soluble in polar solvents like water, dimethyl formamide, methanol and acetonitrile.

The infra-red spectra of all the complexes (mull as well as in KBr pellet) are identical irrespective of the central metal or the number of DMSO molecules attached to it. A displacement of $S=O$ stretch towards lower frequency suggests co-ordination of the metal through the oxygen atom of the ligand.⁵ Comparing the extent of this shift with that observed in transition metal halide complexes of DMSO⁵ it is evident that the metal-oxygen bond in the lanthanon complexes is weaker. An enhancement of C-S stretching frequency further confirms the complex formation. Data for typical compounds are given in Table I.

TABLE I
Infra-red and conductivity data

Compound	Infra-red in KBr pallet		λ_m (mhos $cm.^2$ mole $^{-1}$)	
	S=O stretch $cm.^{-1}$	C-S stretch $cm.^{-1}$	In DMF	In DMSO
DMSO	1055	690	..	..
$La(Cl)_3 \cdot 4DMSO$	1010	718	97.79	107.3
$Gd(Cl)_3 \cdot 4DMSO$	1012	718	21.24	110.6
$Y(Cl)_3 \cdot 3DMSO$	1010	720	92.4	110.6

Note.—Molar conductances (λ_m) are reported for 0.001 M solutions at 30°C. In DMF, λ_m for 1:1 electrolytes is about 85 and in DMSO for 1:3 electrolytes is about 100 mhos $\times cm.^2$ mole $^{-1}$.

Molecular conductance in acetonitrile (a poor donor) shows that the complexes are non-electrolytes suggesting a formal co-ordination

number of 7 for rare-earth elements and 6 for yttrium. However, the co-ordination number can exceed the formal value in view of the ability of chlorine atoms to enter into bridged-type structures.⁶ The conductance data in dimethyl formamide (DMF) can be explained on this basis. The complexes exhibit 1:1 electrolytic behaviour in DMF solution showing that one chlorine is replaced by a DMF (better donor than acetonitrile) molecule and is therefore differently bound from the other two. Probably, two of the chlorine atoms are involved in bridging while the replaceable one is free. Further proof about co-ordination number can best be obtained from X-ray studies. The conductivity data in DMSO solution show that the complexes dissociate completely to give 1:3 electrolytes, presumably because DMSO being a better donor than DMF replaces all the chlorine atoms in the co-ordination sphere.

The authors are thankful to Prof. M. R. A. Rao for his keen interest in the work.

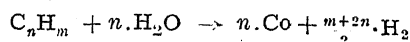
Dept. of Inorganic and Physical Chemistry,
Indian Institute of Science,
Bangalore-12, March 15, 1966.

S. K. RAMALINGAM.
S. SOUNDARARAJAN.

1. Cotton, F. A. and Francis, R., *J. Amer. Chem. Soc.*, 1960, **82**, 2986.
2. — and —, *J. Phys. Chem.*, 1960, **64**, 1534.
3. Selbin, J., Bull, W. E. and Holmes, L. H., Jr., *J. Inorg. Nucl. Chem.*, 1961, **16**, 219.
4. Meek, D. W., Straub, D. K. and Drago, R. S., *J. Amer. Chem. Soc.* 1960, **82**, 6013.
5. Drago, R. S. and Meek, D., *J. Phys. Chem.*, 1961, **65**, 1446.
6. David, G., Holah and John, P. Fackler, Jr., *Inorg. Chem.*, 1965, **4** (12), 172.

ON THE SELECTIVE CATALYTIC
STEAM-OXIDATION OF MIXED
HYDROCARBONS

THE steam-hydrocarbon reaction, represented generally by



has been mostly exploited for industrial utilisation of natural gas and refinery gases towards the manufacture of synthetic ammonia, synthesis gas, etc., and, in recent years, hydrogen also. All these processes necessitate the complete conversion of hydrocarbons into oxides of carbon and hydrogen with the least possible carbon deposition on the catalyst. However, the potentialities of developing sophisticated processes using partial or selective steam-oxidation of mixed hydrocarbons for meeting special needs are immense. One such example of a limited

few as already reported in literature is the recent development of a process in Britain¹ briefing the conversion of liquid hydrocarbons to high calorific value gas containing mainly methane. In absence of adequate data on the subject it is not possible at the present moment to predict the nature and extent of the selective reaction with steam which the different gaseous hydrocarbons of a mixture would undergo under different variable conditions. An investigation was undertaken in this direction to develop a process for obtaining a gas containing only methane and hydrogen by selective steam-oxidation of a cracked oil-gas having the following approximate composition:

40% saturates containing 80-90% methane,
40% unsaturates containing 50% ethylene,
30% propylene and 20% butylenes,
10% hydrogen, and
10% nitrogen and traces of oxygen, carbon monoxide and carbon dioxide.

methane might be possible under specific conditions.

For this purpose, earlier attempts to use Kieselguhr supported nickel and iron catalysts did not meet with much success owing to physical damage of the catalyst caused by repeated oxidation of the carbon depositing heavily on the catalyst surface. However, silica-gel supported nickel catalyst was found to be highly satisfactory, and with this catalyst a detailed study of steam-oxidation of mixed hydrocarbons of the aforesaid composition was carried out under the following conditions in a flow system of fixed-bed reactor at atmospheric pressure:

Catalyst: 10 Ni : 90 SiO_2 .

Temperature: 300° to 800° C.

Gas Space Velocity: 1,000 and 2,000 hr^{-1} (NTP).

Carbon to Steam Ratio ($\text{C}:\text{H}_2\text{O}$): 1:1.

The results, shown graphically in Figs. 1 and 2, can be briefly summarized as follows:

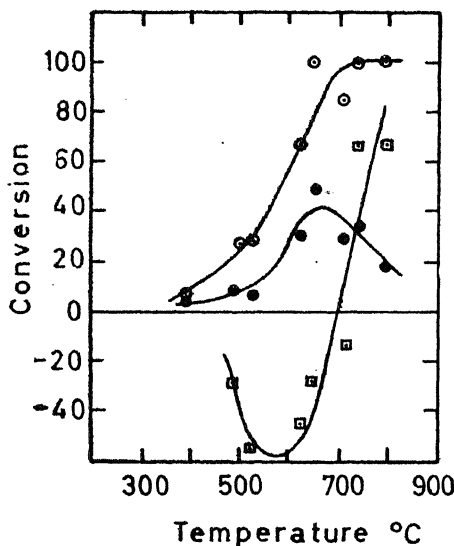


FIG. 1

FIGS. 1-2. Fig. 1. Conversion *vs.* Temperature at a gas space velocity of 1,000 cm^3 of gas (NTP)/ cm^3 catalyst/hour. Fig. 2. Conversion *vs.* Temperature at a gas space velocity of 2,000 cm^3 of gas (NTP)/ cm^3 catalyst/hour.

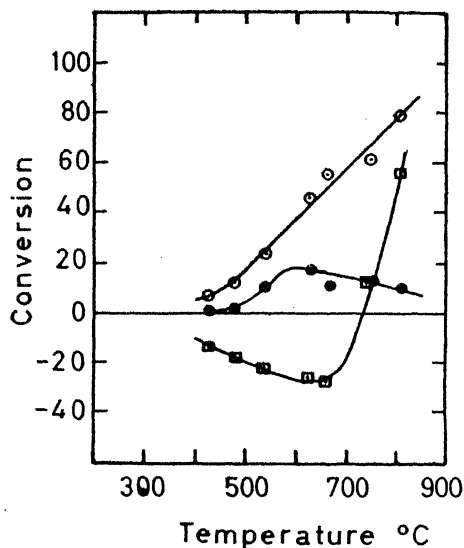


FIG. 2

○ Percent of hydrocarbons other than methane converted. ● Percent carbon deposition on total quantity of hydrocarbons other than methane passed. ◻ Percent methane converted.

In an earlier investigation conducted in this laboratory² on the 'catalytic steam-oxidation of methane-rich gases for conversion into synthesis gas' it was observed that under some condition of low partial conversion the unconverted gas was totally free from C_2 and higher hydrocarbons. In the light of this observation it was expected that a selective total oxidation of higher hydrocarbons with little or no reaction of

Between 300° and 600° C. methane does not react with steam, instead its concentration increases (which can be seen from the negative conversion values in the graphs), apparently from the reactions of other hydrocarbons, resulting in its maximum yield in the product gas to a temperature between 600° and 650° C. Beyond 650° C. the rate of conversion of methane to oxides of carbon increases sharply

solution of 0.25 M CuCO_3 and 0.1 M H_2SO_4 .³ A known amount of freshly distilled A.R. hydrochloric acid was added to the sulphate bath and the deposition was carried out at 2 mA/cm.² to a thickness corresponding to 10 coulombs/cm.² at laboratory temperature. Fresh solution was used for each experiment. The overpotential was measured with reference to a freshly prepared copper electrode, using V.T.V.M. with an accuracy of ± 5 m.V. The surface appearance of deposit was examined by phase contrast microscopy.



FIGS. 1-3. Growth of copper deposited on Cu (100) from acid copper sulphate bath at 2 mA/cm.². Thickness 10 C ($\times 500$). Fig. 1. Layer type of growth. Fig. 2. Ridge type in presence of 10^{-3} M/l. of HCl. Fig. 3. Triangular pyramidal (and dendritic) growth in presence of 4×10^{-3} M/l. HCl.

A layer type of growth was obtained when copper was deposited from purified acid copper

sulphate bath at low current densities, as noticed by earlier workers⁴ (Fig. 1). It was observed that the distance between steps in the layer type of deposit decreases as the concentration of hydrochloric acid was increased from 10^{-10} to 10^{-4} M/l. When the concentration of HCl was 10^{-3} M/l., the layer type of deposit was completely transformed into ridge type of deposit as illustrated in Fig. 2. It is seen that the ridges are perpendicular to the layers. Figure 3 shows that the ridges grow bigger and break up to give rise to triangular pyramids and dendritic growth which are really twinned triangular pyramids when the concentration was 4×10^{-3} M/l. of hydrochloric acid in the bath. On further increases of hydrochloric acid concentration to 10^{-2} M/l., the deposit obtained consists of more dendrites and polycrystalline material. In all the above cases the deposit looks bright. When the concentration of HCl was 10^{-1} M/l., the deposit was polycrystalline and the surface appeared dull.

The overpotential during the deposition from very pure solution, increases from 35 mv to 50 mv and becomes constant as noticed earlier.³ When the chloride ions are present as an impurity up to a concentration of 4×10^{-3} M/l., the initial overpotential is always higher (about 45 mv). However as the deposition proceeds the potential remains constant during ridge type of growth but it decreases steadily when triangular pyramids and dendrites are formed. The initial overpotential is lower (30 mv) at 10^{-2} M/l. hydrochloric acid. The overpotential increases slightly in the earlier part of the deposition and decreases to a constant overpotential of 30 mv.

The above results indicate the remarkable effect of chloride ions on the habit modification of copper electrodeposit and on overpotential during deposition. The mechanism of habit modification due to chloride ions is under detailed study.

The authors are thankful to Dr. M. Shadaksharaswamy for his kind encouragement.

Department of Chemistry, T. H. V. SETTY.
Central College, Bangalore-1. S. NAGESWARA.
January 22, 1966.

1. Mukhin, V. A. and Levin, A. I., *Tsvetn Metal*, 1964, **37**, 36, (RUSS); *C.A.*, 1965, *g*, 10071, 62.
2. Jacquet, P., *Cmpt. rend.*, 1933, **202**, 402.
3. Damjanovic, A., Paunovic, M. and Bockris, J. o'M., *J. Electroanal. Chem.* 1965, **9**, 93.
4. Pick, H. J., Storey, G. G. and Vughan, T. B., *Electrochim. Acta*, 1960, **2**, 165.

SUITABILITY OF ARTHROBACTER SPECIES FOR THE ASSAY OF GLUTAMATE AND CERTAIN VITAMINS

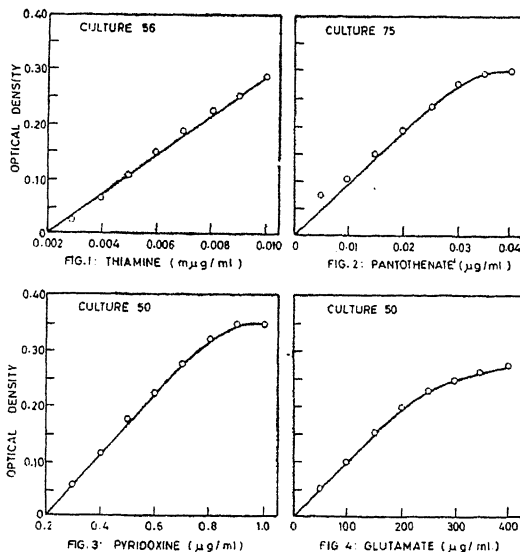
THE genus *Arthrobacter* contains a number of bacteria which show a definite requirement for one or more growth factors. Lochhead and Burton¹ described *Arthrobacter* species demanding vitamin B₁₂ along with thiamine alone or with thiamine and biotin. Lochhead² subsequently listed two other new species, one requiring vitamin B₁₂ and the other *terregens* factor. Chan and Stevenson³ recently reported that even the type species, *A. globiformis*, is biotin-dependent.

In the course of our studies on the isolation and characterization of *Arthrobacter* group of organisms grown in enrichments set with 0.2% glycine we came across several members in the soil and sewage which exhibited a clear-cut demand for a variety of growth factors. In order to assign a taxonomic position to these exacting group of *Arthrobacter*, we have divided them into five different groups. The first group, comprised of the soil-dwelling species, demanded only thiamine for growth when cultured in a mineral-based solution used by Khambata *et al.*⁴ containing glucose as the sole organic nutrient. The second group, which also were soil species, demanded thiamine and pantothenate and seemed to have a partial requirement for biotin in the sense that the vitamin was growth-stimulatory, though not essential. The third group, derived from sewage and activated sludge, demanded thiamine, pyridoxine and glutamate and, for this group also, biotin was growth-stimulatory. The fourth group of organisms, isolated from soil, showed an absolute demand for thiamine, pantothenate and glutamate, though to some extent methionine and cysteine could substitute for glutamate. The fifth group, comprised of soil and sewage species, were exacting to glutamate only and could grow well without growth factors.

Besides the above, a large number of soil *Arthrobacter* strains, tentatively identified as *A. ureafaciens*, made a demand for biotin when cultured in a medium containing glycine (as the sole source of carbon and nitrogen) but not in that containing glucose and ammonium sulphate. It is likely that glucose in the latter medium serves as a 'biotin sparing' agent. It may be pointed out here that species in group 3 also had a need for biotin when cultured in the medium containing 0.5% glutamate. This observation is in line with that reported by Chan⁵ for *A. globiformis* to the effect that the

species could grow well in sucrose but not in glucose-containing medium without added biotin during the 1st transfer, sucrose in this instance acting as the 'biotin sparing' agent.

The demand for particular growth factor(s) by the *Arthrobacter* species studied is absolute and specific. It is clear from Figs. 1-4 that there



FIGS. 1-4. Fig. 1. Growth response of cultures three vitamins and glutamate. Fig. 2. Culture No. 56 (*Arthrobacter*, group III) to thiamine. Culture No. 75 (*Arthrobacter*, group II) to pantothenate. Fig. 4. Culture No. 50 (*Arthrobacter*, group III) to pyridoxine and glutamate.

is a graded response in growth to varying concentration of each growth factor and/or glutamate. Needless to emphasise that the ease with which these organisms can be cultured and maintained in the laboratory (on nutrient agar) and the absolute demand they make for a specific growth factor render them suitable for the detection and estimation of such factors in biological materials.

Fermentation Tech. Lab., M. F. MULLAKHANDHAI.
Indian Inst. of Science, J. V. BHAT.
Bangalore-12, February 9, 1966.

1. Lochhead, A. G. and Burton, M. O. *Can. J. Microbiol.*, 1955, **1**, 319.
2. —, *Arch. Mikrobiol.*, 1958, **31**, 163.
3. Chan, E. C. S. and Stevenson, I. L., *Can. J. Microbiol.*, 1962, **8**, 403.
4. Khambata, S. R., Iyer, V., Iyer, R. V., Bhat, M. G. and Bhat, J. V., *Indian J. Agric. Sci.*, 1960, **30**, 91.
5. Chan, E. C. S., *J. Bact.*, 1964, **87**, 641.

ON THE VARIATIONS IN RHIZOSPHERE EFFECTS OF SOME CROP PLANTS

THE importance of rhizosphere microflora and their relationship with plant life has been clearly indicated by Clark,¹ Katznelson *et al.*² and Starkey.³ That the rhizosphere effect varies with the plant species, its age and vigour as also the soil type, its moisture content and cultural treatment given to it, has been brought out by several other studies. Of the various factors influencing the rhizosphere effect, soil depth is one which has not been studied in greater detail, except for a few reports.^{4,5} In the present report evidence is presented on the influence of plant species and soil depth on the rhizosphere effect.

Five of the common crops, known for their differences in root length, were grown under identical conditions in a field of uniform fertility in the Annamalai University Experimental Farm. The crops included under the study were gingelly TMV 2 (*Sesamum indicum* L.), ragi Co. 7 (*Eleusine coracana* Gaertn.), sunnhemp (*Crotalaria juncea* L.), redgram S.A. 1 [*Cajanus cajan* (L.) Millsp.], and cotton MCU 3 (*Gossypium hirsutum* L.). For analysing the rhizosphere population, the plants were selected at random from the four replications, carefully

dug out with a block of soil in tact around the roots, and then the soil was gently broken to release the root system. The root samples at desired soil depths were transferred to sterile water blanks. The rhizosphere and soil microbial populations were estimated following the same procedure as was adopted by Rangaswami and Venkatesan.⁵ The populations were estimated using soil extract agar for bacteria, KenKnight's agar for actinomycetes, dextrose peptone yeast extract agar for fungi, and Waksman's base medium No. 77 for *Azotobacter*.

The lengths of roots of the crop plants when 20 and 40 days old are given in Table I. The

TABLE I

A comparison of the root lengths of the five crop plants

Crop	Root length in inch	
	20 days old	40 days old
Gingelly TMV 2	.. 2.8	3.2
Ragi Co. 7	.. 3.1	5.8
Sunn hemp (local)	.. 5.4	6.5
Redgram S.A. 1	.. 5.8	9.3
Cotton MCU 3	.. 3.1	6.2

data on the bacterial, actinomycete, fungal and *Azotobacter* populations at different soil depths are given in Table II, and the rhizosphere

TABLE II

A comparison of the microbial population of the soil and rhizosphere of the five crop plants
(Population expressed as 10^6 /g. of moisture free soil)

Age of the plant in days	Bacteria 10 ⁶ /g.		Actinomycetes 10 ⁶ /g.		Fungi 10 ⁴ /g.		Azotobacter 10 ³ /g.		
	20	40	20	40	20	40	20	40	
Rhizosphere sample:									
Gingelly :									
0-3 inch layer	..	191.70	268.0	0.98	1.32	16.62	17.63	2.17	2.22
3-6
6-12
Ragi:									
0-3	..	206.60	258.35	0.99	1.34	10.98	11.24	2.32	2.32
3-6	203.99	..	0.59	..	8.78	..	0.94
6-12
Sunn hemp:									
0-3	..	694.55	1017.98	1.12	1.58	13.91	11.44	18.63	20.32
3-6	..	630.00	817.15	0.65	1.21	8.58	8.90	7.16	12.44
6-12
Redgram:									
0-3	..	930.12	1169.91	0.85	1.28	3.13	13.28	9.97	9.98
3-6	..	792.40	938.72	0.45	0.82	7.93	10.12	3.02	6.24
6-12	451.18	..	0.38	..	8.97	..	2.04
Cotton:									
0-3	..	374.07	512.84	1.16	1.68	10.21	10.99	2.46	3.48
3-6	437.48	..	1.06	..	7.79	..	1.82
6-12
Soil sample:									
0-3	..	16.85	19.28	0.73	1.00	3.69	2.92	2.15	2.20
3-6	..	13.55	14.75	0.38	0.61	2.18	2.22	0.64	1.12
6-12	..	2.93	6.92	0.37	0.20	0.85	1.99	0.17	0.17
12-18	..	1.53	2.23	0.19	0.20	0.19	0.62	..	0.03

ON THE VARIATIONS IN RHIZOSPHERE EFFECTS OF SOME CROP PLANTS

THE importance of rhizosphere microflora and their relationship with plant life has been clearly indicated by Clark,¹ Katznelson *et al.*² and Starkey.³ That the rhizosphere effect varies with the plant species, its age and vigour as also the soil type, its moisture content and cultural treatment given to it, has been brought out by several other studies. Of the various factors influencing the rhizosphere effect, soil depth is one which has not been studied in greater detail, except for a few reports.^{4,5} In the present report evidence is presented on the influence of plant species and soil depth on the rhizosphere effect.

Five of the common crops, known for their differences in root length, were grown under identical conditions in a field of uniform fertility in the Annamalai University Experimental Farm. The crops included under the study were gingelly TMV 2 (*Sesamum indicum* L.), ragi Co. 7 (*Eleusine coracana* Gaertn.), sunnhemp (*Crotalaria juncea* L.), redgram S.A. 1 [*Cajanus cajan* (L.) Millsp.], and cotton MCU 3 (*Gossypium hirsutum* L.). For analysing the rhizosphere population, the plants were selected at random from the four replications, carefully

dug out with a block of soil in tact around the roots, and then the soil was gently broken to release the root system. The root samples at desired soil depths were transferred to sterile water blanks. The rhizosphere and soil microbial populations were estimated following the same procedure as was adopted by Rangaswami and Venkatesan.⁵ The populations were estimated using soil extract agar for bacteria, KenKnight's agar for actinomycetes, dextrose peptone yeast extract agar for fungi, and Waksman's base medium No. 77 for *Azotobacter*.

The lengths of roots of the crop plants when 20 and 40 days old are given in Table I. The

TABLE I

*A comparison of the root lengths of the
five crop plants*

Crop	Root length in inch	
	20 days old	40 days old
Gingelly TMV 2	2.8	3.2
Ragi Co. 7	3.1	5.8
Sunn hemp (local)	5.4	6.5
Redgram S.A. 1	5.8	9.3
Cotton MCU 3	3.1	6.2

data on the bacterial, actinomycete, fungal and *Azotobacter* populations at different soil depths are given in Table II, and the rhizosphere

TABLE II

*A comparison of the microbial population of the soil and rhizosphere of the five crop plants
(Population expressed as 10⁶/g. of moisture free soil)*

Age of the plant in days	Bacteria 10 ⁶ /g.		Actinomycetes 10 ⁶ /g.		Fungi 10 ⁴ /g.		<i>Azotobacter</i> 10 ³ /g.	
	20	40	20	40	20	40	20	40
Rhizosphere sample:								
Gingelly:								
0-3 inch layer	191.70	268.0	0.98	1.32	16.62	17.63	2.17	2.22
3-6	..	..	..	..	..	..	..	..
6-12	..	..	..	..	..	..	..	..
Ragi:								
0-3	206.60	258.35	0.99	1.34	10.98	11.24	2.32	2.32
3-6	..	203.99	..	0.19	..	8.78	..	0.94
6-12	..	..	..	..	..	..	..	..
Sunn hemp:								
0-3	694.55	1017.98	1.12	1.58	13.91	11.44	18.63	20.32
3-6	630.00	817.15	0.65	1.21	8.58	8.90	7.16	12.44
6-12	..	..	..	..	..	..	..	..
Redgram:								
0-3	930.12	1169.91	0.85	1.28	3.13	13.28	9.97	9.98
3-6	792.40	938.72	0.45	0.82	7.93	10.12	3.02	6.24
6-12	..	451.18	..	0.38	..	8.97	..	2.04
Cotton:								
0-3	374.07	512.84	1.16	1.68	10.21	10.99	2.46	3.48
3-6	..	437.48	..	1.06	..	7.79	..	1.82
6-12	..	..	..	..	..	..	..	..
Soil sample:								
0-3	16.85	19.28	0.73	1.00	3.69	2.92	2.15	2.20
3-6	13.55	14.75	0.38	0.61	2.18	2.22	0.64	1.12
6-12	2.93	6.92	0.37	0.20	0.85	1.99	0.17	0.17
12-18	1.53	2.23	0.19	0.20	0.19	0.62	..	0.03

TABLE III
Rhizosphere effect due to roots of five crop plants, collected from different depths of soil

Age of the plants in days	Rhizosphere Effect on								
	Bacteria		Actinomycetes		Fungi		<i>Azotobacter</i>		
	20	40	20	40	20	40	20	40	
Gingelly:									
0-3 inch layer	..	11.38	13.9	1.3	1.32	4.5	6.03	1.0	1.0
3-6
6-12
Ragi:									
0-3	..	12.25	13.4	1.35	1.34	2.97	3.84	1.1	1.05
3-6	13.83	..	1.62	..	3.95	..	..
6-12
Sunn hemp:									
0-3	..	41.6	52.8	1.53	1.58	3.77	3.92	8.82	9.23
3-6	..	46.49	55.4	1.71	1.98	3.93	4.01	11.2	11.10
6-12
Redgram:									
0-3	..	55.2	60.68	1.16	1.28	3.28	4.54	4.64	4.53
3-6	..	58.48	63.64	1.18	1.34	3.64	4.56	4.72	5.57
6-12	65.2	..	1.90	..	4.62	..	12.00
Cotton:									
0-3	..	22.2	26.6	1.59	1.68	2.76	3.42	1.1	1.58
3-6	29.65	..	1.73	..	3.51	..	1.61
6-12

effects (rhizosphere: soil ratios) are indicated in Table III.

The results show that the rhizosphere effect varied with (i) the crop species, (ii) depths of the soil wherefrom the root samples were collected, (iii) age of the plant, and (iv) groups of the micro-organism concerned. When the root samples were collected from different soil depths, the effect was progressively more in the deeper layers, in all the crop species. Greater numbers of micro-organisms, especially bacteria, were found on the roots of legumes, as compared to the non-legumes. An increased rhizosphere effect was observed on the 40th day than on the 20th in all the crop species. Of the five plant species examined, the rhizosphere effect on bacteria was maximum in redgram, followed by sunnhemp and cotton. The effect on actinomycetes was more in cotton than in the other crops, the least being in redgram. Gingelly roots stimulated the fungi to an appreciable extent, followed by redgram, sunnhemp, ragi and cotton, respectively. The rhizosphere of legumes harboured more of *Azotobacter* than the non-legumes. These results are similar to the ones reported earlier by other workers for different plant species.^{2,6} The increased rhizosphere: soil ratio in deeper soil layers appears to be mainly due to the lesser number of organisms present in the soil at the lower layers. This observation supports the earlier finding by Rangaswami and Venkatesan⁵

that when rice plant is grown in a soil, not only the roots selectively activate the soil micro-organisms through the rhizosphere effect, but the microflora are turned over from the surface to deeper layers.

Microbiology Laboratory, JOSEPH BAGYARAJ.
Faculty of Agriculture, G. RANGASWAMI.*
Annamalai University,
Annamalainagar, December 14, 1965.

* Present address: University of Agricultural Sciences, Bangalore-6.

1. Clark, F. E., *Adv. Agron.*, 1949, **1**, 241.
2. Katznelson, H., Lochhead, A. G. and Timonin, M. I., *Bol. Rev.*, 1948, **14**, 540.
3. Starkey, R. L., *Bact. Rev.*, 1958, **22**, 154.
4. Ivarson, K. C. and Katznelson, H., *Plant and Soil*, 1960, **12**, 30.
5. Rangaswami, G. and Venkatesan, R., *Curr. Sci.*, 1964, **33**, 181.
6. Katznelson, H. and Strzelczyk, E., *Canad. J. Microbiol.*, 1961, **7**, 437.

A LEAF DISEASE OF AVOCADO CAUSED BY *COLLETOTRICHUM* *GLOEOSPORIODES* (PENZIG) SACCARDO

In an orchard near Bangalore, some of the Avocado trees (*Persea gratissima* Gaertn.) were found to be affected by a leaf disease. Both mature and young leaves were affected. The infected leaves presented a parched or

singed appearance in advanced stages of infection, the chief damage being due to the destruction of the lamina. The disease was first noticed by us in June/July (1965) breaking out in rather restricted areas, extending gradually with the onset of regular monsoon rains. At first the spots were seen appearing at the tip of the leaves; they were pale green, water-soaked patches, slowly becoming dry and turning ultimately reddish-brown in colour. The spots were mostly contiguous, the necrotic areas cracking and falling away in some instances. In many cases, only the upper half of the leaf was affected and in a few instances, however, the entire leaf was affected resulting in partial defoliation of some branches.

The fungus sporulates abundantly producing on the upper surface of the leaves, buff to salmon coloured conidial masses which ultimately turn black.

In microscopic preparations, the fungal mycelium was found to be intercellular, upto 2μ in diameter; the stromata formed on the upper surface of the leaves are subcuticular composed of subhyaline, pseudoparenchymatous cells with simple cylindrical conidiophores measuring upto 20μ long, each producing conidia, terminally singly and successively. No acervular setae were recorded. Conidia, cylindrical, hyaline, continuous, with rounded ends, $12-21 \times 3-6\mu$.

This is perhaps the first report of *Colletotrichum glaucosporioides* as the cause of a leaf disease in Avocado pear.

From the literature it would appear that *Colletotrichum crassipes* (Speg.) von Arx¹ was reported earlier as *Glauosporium perseae-drymifoliae* Calvino, from San Remo, Florida, on fruits and twigs of *Persea drymifolia* Cham. and Schlecht. On leaves of *Persea gratissima*, however, three species of *Pestalotia*² were recorded namely, *Pestalotia adusta* Ell. and Ev. from Bayanon, Puerto Rico, *P. mangiferae* P. Henn. from Miami, Florida, and *P. eugeniae* Thume. as *P. eriobotryae-Japoniceae* Sawada from Taihoju, Formosa.

We are grateful to Mr. P. de Jong, General Manager, Fertiliser and Pesticide Division, Rallis India Limited, for permission to publish this note and to Drs. Deighton and Mordue of the Commonwealth Mycological Institute, England, for confirming the identity of *Colletotrichum glaucosporioides*.

Fertiliser & Pesticides Dvn., V. AGNIHOTHURU.
Rallis India Limited, M. M. MADAPA.
Post Box No. 68,
Bangalore-1, December 6, 1965.

1. von Arx, J. A., *Revision der Zu Glauosporium Gestellten Pilze*, 1957, pp. 153.
2. Guba, E. F., *A Monograph of Monochatia and Pestalotia*, 1961, pp. 342.

A NEW HELMINTHOSPORIUM DISEASE OF BAJRA

DURING the month of September, 1964 a severe and extensive leaf-spot disease of Bajra (*Pennisetum typhoides* Stapf and Hubb) was noticed at the Punjab Agricultural University farm, Ludhiana. Isolations from the diseased leaves consistently yielded a species of *Helminthosporium*. The culture of the fungus was sent to the Commonwealth Mycological Institute, Kew, where it was identified as *Helminthosporium australiense* Bugnicourt. This fungus was first reported by Bugnicourt¹ from rice seeds in New South Wales. A careful survey of the lists of fungi reported showed that there was no previous record of this organism occurring on Bajra and therefore it is described here as a new record on Bajra. This species is not recorded so far on any crop in India.

The fungus initiates small brown spots on the leaves which gradually increase in size ultimately covering the entire leaflet often coalescing to form bigger blotches. In severe attack most of the leaves in a plant become infected and the whole plant ultimately dries up.

The organism isolated and cultured on P.D.A. forms a colony consisting of appressed, spreading, septate, dark mycelium which measures $4.16-6.59\mu$ in breadth. Conidiophores measuring $13-35$ by $2-3\mu$.

A culture of the fungus has been deposited in the C.M.I., Kew, England, as No. 115373 and in the Botany and Plant Pathology Department, Punjab Agricultural University, Hissar.

The authors wish to express their grateful thanks to Dr. D. Suryanarayana for his keen interest and to Dr. Ellis of C.M.I., Kew, for identifying the fungus.

Dept. of Botany and
Plant Pathology,
Punjab Agri. University,
Hissar, December 6, 1965.

J. N. CHAND.
BUTA SINGH.

1. Bugnicourt, F., *Rev. Gen. Bot.*, 1955, **62**, 238.

REVIEWS AND NOTICES OF BOOKS

The Amino Sugars—The Chemistry and Biology of Compounds Containing Amino Sugars, Vol. II A. Edited by E. A. Balazs and R. W. Jeanloz. (Academic Press, New York and London), 1965. Pp. xxiii + 591. Price: \$22.00; List Price: \$19.50; Subscription Price valid until publication of last volume.

The present volume deals with the distribution and biological role of amino sugars and amino sugar-containing macromolecules in plants and animals. This systematic review includes all living systems, organized according to tissues and organs, and represents a pioneering effort on the part of the authors.

The titles of the chapters contained in this volume are as follows: Distribution of Amino Sugars in Micro-organisms, Plants, and Invertebrates, by Nathan Sharon; Amino Sugars and Macromolecules Containing Amino Sugars in Liver, by Robert G. Spiro; Amino Sugars and Macromolecules Containing Amino Sugars in Kidney, by Robert G. Spiro; Amino Sugar-Containing Compounds in Urine, by Norman F. Boas; Amino Sugar-Containing Compounds in Mucuses and in Mucous Membranes, by Zacharias Dische; Glycoproteins in Salivary Glands, Saliva, and Sputum, by I. Werner and L. Odin; Glycosaminoglycans and Glycoproteins in Skin, by R. H. Pearce; Amino Sugar-Containing Compounds in Tumors, by B. Sylven; Amino Sugar-Containing Compounds in Pathological Effusions, by I. Werner and L. Odin; Glycosaminoglycans in Mast Cells and in Mast-Cell Tumors, by Nils R. Ringertz; Glycosaminoglycans in Umbilical Cord, by J. A. Szirmai; Glycosaminoglycans and Glycoproteins in Synovial Fluid, by Lars Sundblad; Glycosaminoglycans in the Connective Tissue of the Electric Organ, by J. A. Szirmai; Amino Sugar-Containing Compounds in Cartilage, Tendon, and Intervertebral Disc, by Maxwell Schubert and David Hamerman; The Amino Sugar-Containing Compounds in Bones and Teeth, by E. A. Balazs and H. J. Rogers; Glycosaminoglycans and Glycoproteins in Blood-Vessel Walls, by Helen Muir; Glycoproteins and Glycosaminoglycans in Plasma and in Some Other Body Fluids, by Richard J. Winzler; Substances Containing Amino Sugars in Blood Cells and in Hemopoietic Organs, by Sen-itiroh Hakomori; Glycolipids and Other Amino Sugar-Containing Compounds in the Nervous System, by Lars

Svennerholm; Amino Sugar-Containing Macromolecules in the Tissues of the Eye and the Ear, by E. A. Balazs. C. V. R.

Recent Progress in Hormone Research (Vol. 21). Edited by Gregory Pincus. (Academic Press, New York and London), 1965. Pp. viii + 679. Price \$24.00.

The 1964 Laurentian Hormone Conference met during the period September 7 to 12 in Hotel Sagamore at Bolton Landing on Lake George, New York. The record of that meeting is in the papers and the discussions of these papers which appear in this volume. The subject-matter has been dealt with under six headings whose titles are as follows: I. Recent Advances in Thyroid Chemistry and Physiology: Number of papers presented is two; II. Hormones in Normal and Pathological Physiology: Number of papers presented is two; III. Pituitary Hormones: Number of papers presented is three; IV. Steroid Sex Hormones: Number of papers presented is three; V. Comparative Endocrinology: Number of papers presented is two; and VI. Neurohumors: Number of papers presented is two. Discussions followed after the presentation of each paper.

C. V. R.

Evolving Genes and Proteins. Edited by V. Bryson and H. J. Vogel. (Academic Press, New York and London), 1965. Pp. xxi + 629. Price \$19.50.

This book represents the proceedings of a symposium held at the Institute of Microbiology of Rutgers, The State University, with support from the National Science Foundation. It reflects the impact of current biochemical and genetic achievements on views of biological evolution. Outstanding contributors discuss evolutionary features of DNA, RNA, proteins, and metabolic pathways. The organisms examined in detailed comparative studies range from bacteria to primates.

This volume offers a wealth of material to those interested in macromolecular structure and function, as well as to students of evolutionary relationships and processes. In addition to the experimental information, a balanced and thought-provoking perspective is provided.

C. V. R.

Sensory Restriction: Effects on Behavior. By Duane P. Schultz. (Academic Press, New York and London), 1965. Pp. viii + 216. Price \$ 7.50.

This monograph is an attempt to provide a systematic presentation of the wide variety of experimental findings emerging from the relatively recently and rapidly growing area often referred to as sensory deprivation.

Topics included in this volume encompass: Toward a Unifying Theoretical Framework; Physiological Effects of Sensory Restriction; Cognitive and Learning Effects; Perceptual and Motor Effects; Affective Changes; Differences in Tolerance for Sensory Restriction; Effects of Social Isolation.

This book will be of value to workers in the several disciplines from which the research has proceeded. It will also be found useful as a supplementary text by undergraduate and graduate students in courses such as experimental psychology and motivation.

C. V. R.

Physiology of the Insect Central Nervous System. Edited by J. W. L. Beament and J. E. Treherne. (Academic Press, New York and London), 1965. Pp. ix + 277. Price 60 sh.

Knowledge of the central nervous system ranks very high in importance in the biological sciences. The recent application of a variety of physical and chemical micro-techniques to the study of this system in the insects has resulted in a large body of information which has important implications in fields as far separated as those of animal behaviour and insecticide resistance.

The contributions contained in this volume are the papers collected from the 12th International Congress of Entomology held in London, 1964. They cover a wide range of topics which serve both as a useful summary of our present state of knowledge and also as a stimulus to further research and analysis in a subject of interest to entomologists, neurophysiologists, toxicologists and ethologists alike.

C. V. R.

Metallurgical Society Conferences (Vol. 27). Edited by Cyril Stanley Smith. (Gordon and Breach, Science Publishers, New York, London and Paris), 1965. Pp. xxii + 558. Price: Professional Edition \$12.50; Reference Edition \$29.00.

This volume represents the Proceedings of the Sorby Centennial Symposium on the History

of Metallurgy, sponsored by the Society for the History of Technology, American Society for Metals, and the Metallurgical Society, American Institute of Mining, Metallurgical, and Petroleum Engineers, held at Cleveland, Ohio, from October 22 to 23, 1963.

The contents of this book are: Sorby—The Man and His Background; Sorby: The Father of Microscopical Petrography; A Bibliography of Publications by H. C. Sorby; Henry Marion Howe's Contributions to Metallurgy; John Edward Stead, 1851-1923: The Contributions of Sir Robert Hadfield to Metallurgical Science and Technology; John Oliver Arnold (1859-1930); Autobiographical Notes of a Metallurgist; Metal Structure and the Hardenability of Steel, 1920 to 1940: Personal Recollections; What is a Metal? Faraday and the Alloys of Steel; On the Background and Beginning of Metallography in Germany; The Beginnings of Microscopic Metallography in France and its Effect on the Physical Chemistry of Alloy Steels Prior to 1920; D. K. Tschernoff and the Development of Theory of the Heat Treatment of Steel; The B-Iron Controversy; The Criterion of the Martensite Transformation; On the Widmannstätten Structure; History of Precipitation Hardening; Early History of the Understanding of Recrystallization in Metals; The Development of the Theory of Alloys; The Development of Superlattice Concepts; Note on the Early Stages of Dislocation Theory; Dislocations in Plasticity; History of Some Non-destructive Testing Methods; The Development and Use of Hardness Tests in Metallographic Research; Origins of Quantitative Metallography; History of Field Emission Microscopy; The Development of Ductile Tungsten; The Technology of Iron Manufactured in Britain the Decade 1850-1960; A History of Nickel Steels from Meteorites to Maraging; The History of Soft Magnetic Materials; History of Silicon-Iron; The Role of Powder Metallurgy in the Development of Dispersion-Hardened Materials.

C. V. R.

Organic Chemistry Monographs. Edited by A. T. Blomquist. (Academic Press, Inc., New York and London), 1965.

Volume 3, *Conformation Theory*. By Michael Hanack. Pp. 382. Price \$14.50.

Volume 4, *Fundamentals of Carbanion Chemistry*. By Donald J. Cram. Pp. 289. Price \$9.50.

Volume 3 of this series of Monographs on Organic Chemistry is devoted to that aspect of stereochemistry that has come to be known as

conformational analysis. The various arrangements which a molecule can assume through free rotation or twisting (but not breaking) of bonds are designated as conformations of the molecule. The basic idea of conformational analysis is that certain chemical and physical properties of organic compounds are related to preferred conformations. The book that has been translated from the German manuscript is based on the author's lectures delivered at the University of Tübingen. As such the treatment is systematic and lucid. Thus the book will serve as an excellent introduction to the subject to research workers in this field.

The first chapter is an introductory chapter in which the historic development of stereochemistry is briefly given. This is followed by a chapter on general discussion on conformational analysis and its application. Then follow six other chapters which deal with conformational analysis of specific classes of compounds. Because of the author's personal interest in the field, the chapters on the conformation of monocyclic and polycyclic compounds without heteroatoms have been covered in greater detail than those on heterocyclic compounds and acyclic diastereomers.

Volume 4 of the Monograph series is on carbanion chemistry by Donald J. Cram. The role of carbanions (negatively charged carbon) as intermediates in organic chemical reactions has become a subject of growing study in recent years, and the literature on these is widely dispersed. The book collects and integrates the available information and presents the carbanion theory in broad outline.

In Chapter I the variation of the thermodynamic and kinetic acidities of carbon acids with substituents and environments serve to introduce the subject. Chapter II deals with the modes of carbanion stabilization by substituents. The stereochemistry of hydrogen-deuterium exchange and of organometallics is discussed in Chapter III. This is followed by a more general description of carbanion stereochemistry in Chapter IV. Chapter V is concerned with unsaturated anionic rearrangements, and Chapter VI with other rearrangements.

A. S. G.

Water Stress in Plants. Edited by B. Slavik. (Dr. W. Junk, Publishers, 13, van Stolkweg, The Hague, The Netherlands), Pp. 322. Price 25 Dutch Guilders or \$ 6.95.

The volume is the Proceedings of a symposium held in Prague on September 30 to October 4,

1963, on *Water Stress in Plants*. The word "stress" is used in the sense it is commonly used in medicine and animal physiology to express a special state of the living body in the case of illness. Plant is a living organism, and lack of water constitutes a pathological state. The symposium papers are chiefly concerned with investigations on the mechanisms of distribution and movement of water in the plant organism and the way in which physiological processes are influenced by water deficiency. Water deficiency is a major factor limiting plant production, and this is the first symposium of the kind arranged on this important subject.

More than 50 participants, mostly from Czechoslovakia but also from other North European countries Poland, Austria, Germany, USSR, Norway, Sweden, the Netherlands, and Great Britain took part in this symposium. Nearly 30 papers giving results of original investigations on various aspects of the problem were presented and discussed. They were grouped under the following main heads: Water Stress and Water Uptake; Water Stress in Cell, Tissue, and Plant; Water Stress and Physiological Activity; Water Stress and Water Balance.

The *Proceedings*, containing these papers and also the authorized recordings of the discussions, forms a valuable monograph on the subject. It gives not only the results of latest studies on the subject from different centres of research but also paves the way for important and co-ordinated future work on water relations in plants.

A. S. G.

Living Tissues: An Introduction to Functional Histology. By R. L. Holmes. (Pergamon Press), 1965. Pp. 142. Price 15 sh. net.

Histological studies using the light microscope still occupy a major place in biological investigations. This introductory book gives in four chapters a clear account of the fundamentals of histology. The first chapter deals with the principles and techniques involved in histological and histochemical studies of tissues. The second chapter deals with cells and intercellular materials. In the third chapter on Organization of Tissues, some of the main types of tissues are considered to illustrate the relationship between structural organization and function. The final chapter of the book is a brief consideration of the differentiation of cells and tissues. The book contains 15 figures, and 9 plates depicting 36 sections of tissues, cells, electron micrographs, etc.

An extremely well-written book which will serve as an introductory text to senior students entering university to study biology, zoology or medicine.

A. S. G.

Organische Chemie. By R. Müller, H. Fürst, and W. Kirsten. (Veb Verlag Volk and Gesundheit Berlin, Absatzabteilung, 69, Jena, Villengang-2), 1965. Pp. 344. Price. MDN 17.

This manual of Organic Chemistry originally written by Prof. Robert Müller, and revised and enlarged by Dr. Hans Fürst and Dr. Wolfgang Kirsten, has, since its first publication about a decade ago, gone through eight successive editions which shows the popularity of the book in German schools and colleges. The present eighth edition (in German) has brought the book more uptodate, and there is no doubt that it will find a quick sale amongst students of natural science, medicine, agriculture, etc., whose courses include organic chemistry as a subsidiary subject.

A. S. G.

The Indian Year Book of Education 1961—First Year Book—A Review of Education in India (1947-61). Revised Edition. Part I. National Review and Central Programmes), Pp. 420. Price Rs. 17.00 or 40 sh. or \$ 6.

The National Council of Educational Research and Training, New Delhi, has on its programme the production of annual volumes or Year Books devoted to some important aspect of Indian education. For the First Year Book, due for publication in 1961, the choice of the subject was appropriately enough the one on educational development in India in the post-independence period. Accordingly, *A Review of Education in India (1947-61)* was published in August 1961. It was a timely publication at the end of the Second Five-Year Plan and the basic material, in the collection of which both the Central and the State Governments co-operated, supplied a real need in the implementation and projection of plans connected with educational reconstruction and expansion in the country. The edition soon ran out of print leaving a demand for a second edition.

The present publication has been brought out to meet this demand. Considering the bulk of the publication the decision to issue the second edition in two parts is to be welcomed. Part I, under review, has for its title "National Review and Central Programmes". It reviews the development of education in the Centre as a whole and in the Union Territories. Part II

will deal with the development of education in the various States.

This revised publication in which facts and figures have been brought up-to-date will be welcomed by all interested in education in India and its development.

A. S. G.

Potato in India: Varieties. By Pushkarnath. The Indian Council of Agricultural Research, New Delhi), Pp. 465. Price Rs. 25.00.

Systematic scientific research on potato in India is of comparatively recent origin, and the author who has been connected with the Central Potato Research Institute, Simla, since its inception, has brought out in this monograph information on the subject which will be of highly practical value. The book is in three sections. The first two short sections deal in general with the botany, characters and range of variability of the plant, and history and synonymy. The third section, which forms the bulk of the book, deals in detail with each variety under the heads: history, morphological characters, economic characters, disease resistance, effects of different viruses, and general notes. More than 400 varieties including *Desi* varieties, exotics, and hybrids are described.

The monograph is not a mere compilation but it contains the results and experience of more than 20 years of sustained work on the subject. The information contained will no doubt be of practical use in the steps to be taken for the improvement of potato crop on a scientific basis in India.

A. S. G.

Books Received

Introduction to Photographic Principles (2nd Edition). By Lewis Larmore. (Dover Publications, New York-14, N.Y.), 1965. Pp. ix + 229. Price \$ 1.50.

New Light on Space and Time. By D. B. Larson. (North Pacific Publication, P.O. Box 5044, Portland, Oregon), 1965. Pp. vi + 264.

Nonexistent Compounds—Compounds of Low Stability. By W. E. Dasent. (Marcel Dekker, Inc., 95, Madison Ave., New York). Pp. xii + 188. Price \$ 8.75.

Chemical Oceanography. Edited by J. P. Riley and G. Skirrow. (Academic Press, New York), 1965. Pp. xv + 508. Price 115 sh.

The Method of Averaging Functional Corrections Theory and Application. By A. Yu. Luchka. (Academic Press, New York), Pp. xvii + 136. Price \$ 3.45.

THE NEW PHYSIOLOGY OF VISION

Chapter XLI. Photography in Colour

SIR C. V. RAMAN

PICTORIAL photography is made immensely more interesting by the additional feature of colour, thereby making the record resemble more nearly what we observe with our eyes. It is not surprising, therefore, that photography in colour has attained great popularity and that it has received attention from numerous industrial corporations who have sought to provide the means for making it possible, *viz.*, special cameras, photographic films and plates, methods of copying and multiplying the pictures taken, and finally also, projection apparatus for viewing films in colour as transparencies. Numerous techniques have been evolved for obtaining pictures in colour, and several of them have achieved a considerable measure of success and have accordingly been received into popular favour. It is not possible, nor is it proposed here to list these processes or to describe any of them in howsoever cursory a manner. What we are concerned with here is the role played by the characteristics of human vision in colour photography and the extent to which photography in colour can or does succeed in reproducing the appearance of objects as seen with our eyes.

It is evident that the two issues stated above are closely interrelated. For colour photography to be even reasonably successful, it has to take account of and be based upon the characteristics of human vision in respect of the sensations of colour. These characteristics fall into two broad divisions, *viz.*, the sensations excited by the monochromatic radiation appearing in different parts of the spectrum, and the sensations excited by spectrally composite radiation. In most cases, we are concerned with composite radiation, the perceived colour of which is determined by the visual synthesis of the different spectral components of the light which is perceived. These remarks apply equally to the colours of the objects photographed and to their colours as exhibited in a photographic picture. The subject of the visual synthesis of colour thus plays an extremely important role in the field of colour photography.

Colour has such a powerful æsthetic and emotional appeal that a picture or a painting which makes no claim to be a faithful colour-rendering of the object depicted may nevertheless be admired and even highly valued.

Fidelity in the reproduction of colour by photography may to some extent therefore be regarded as being only of academic interest. But this is by no means always the case, especially when colour photography is made use of to convey to a possible purchaser as exact a picture as possible of the article which he desires to obtain. Reproductions of celebrated works of art, of coloured textiles, of ceramic wares and different varieties of favourite flowers may be cited as examples of this situation.

A critical examination of the success or failure of colour photography, in other words, a determination of the measure of success actually achieved by any given process in reproducing colour and of the reasons for its failures, if any, evidently demands a proper choice of the test-objects made use of in the study. It is necessary that the object should display a wide range of colours, and that the spectral composition of the light which emerges from each point of the object should be precisely known and is precisely reproducible. Such a test-object is provided by the colours of interference, produced either in the Newtonian fashion between two polished surfaces of glass having different radii of curvature or between two flat plates of glass very slightly inclined to each other or in some other way. In earlier chapters, the results which emerge from the study of such patterns in various other contexts have already been set out and described, *viz.*, studies of the visual synthesis of colour and studies of defective colour-vision. From these instances, it is evident that the photography of interference patterns in colour would enable us to determine whether the processed colour-films do exhibit the same features as those visually observed in the patterns themselves, and if not, why not.

We begin with interference patterns of the Newtonian type. As usually produced and observed between two spherical surfaces of large radii of curvature, the rings are rather closely spaced and can be properly seen only through a magnifier. Much better suited for our present purpose are the rings produced on a much larger scale between two flat thick plates of glass of the kind ordinarily used for glazing large windows. The processes used in

manufacturing such glass plates result in extensive areas appearing as cylindrical surfaces of very large radius. If two pieces of such glass, each about five centimetres square, are cut out and their edges are smoothed and the faces are placed in contact with their cylindrical axes in crossed positions, perfect circular interference rings of the Newtonian type on a large scale are produced between the surfaces. These rings exhibit the colour sequence in a very striking fashion and do not need a magnifier for enabling them to be critically examined and studied.

Newtonian interference patterns produced in the manner described above have been photographed, using the white light of a tungsten-filament lamp and with colour-films bearing the well-known name of Kodak, and also with different exposures, in view of the influence which the exposure-time is known to exert on the final picture as seen in the processed film. The very striking result then emerged that the photographed colour-film of the interference pattern does not exhibit the colour sequence in the pattern as seen directly, but differs therefrom in a very conspicuous manner. In seeking for an explanation of these differences, a comparison was made between the features seen in the processed film, and the original patterns as viewed through a piece of neodymium glass, which, as is well known, exerts a powerful absorption in the wavelength range between $570\text{ m}\mu$ and $600\text{ m}\mu$ and thereby effectively excludes the yellow sector of the spectrum, its absorption in the rest of the spectrum being relatively negligible. The interference pattern as seen in white light through the neodymium glass, and the same pattern as recorded on the colour-film without the neodymium filter showed many features in common, and could indeed be described as resembling each other closely.

The facts stated above are evidently of such high significance that it seems desirable to proceed to some further detail. The extremely important role played by the yellow sector of the spectrum in determining the features of the Newtonian interference pattern may be demonstrated in the following manner. The pattern is viewed by reflected light, one half of it as seen with white light, and the other as seen with monochromatic yellow light, *e.g.*, the light of a sodium lamp. The two halves appear in juxtaposition, and there is an astonishingly close coincidence between the two sets of rings. Indeed, the rings as seen with sodium light appear as continuations of the rings seen with white light, the first five minima of illumination

which are conspicuously evident in the white-light pattern appearing in positions indistinguishable from the dark rings of the sodium-light pattern.

As viewed through the neodymium glass, as also in the white-light pattern as photographed on a colour-film, we observe in the first place that the rings which are visible are far more numerous. Further, the entire field of interferences exhibits alternate regions which are totally different in their observable characters. In one region we find vivid colours, and this is followed by another in which there is a succession of dark and bright rings with no noticeable colour and this again is followed by a region in which colours are distinctly visible. The removal of the yellow sector by the neodymium filter evidently produces these effects on the interference pattern as seen visually. That the same effects are noticeable in the pattern recorded in the colour-film, indicates that the photographic technique employed for recording colour takes no account of the existence of an independent and extremely powerful yellow sector in the spectrum of white light.

Essentially similar differences are also noticed between the interference pattern of a wedge-shaped air-film as observed visually with white light and as photographed in colour with a Kodak film. Likewise, the pattern visible in white light but with a neodymium glass filter interposed shows a remarkably close correspondence with the features noticed in the photographic colour-film record of the white-light pattern. We draw the same inference, *viz.*, that the photographic techniques used for the reproduction of colour fail to take into account the existence of an independent and extremely powerful yellow sector in the spectrum. In other words, they make the mistake of assuming that the yellow of the spectrum is adequately taken care of when it is regarded as a superposition of the green and the red of the spectrum. This, of course, is one of the fundamental errors which vitiates the trichromatic theory of colour, as has already been demonstrated in other ways in earlier chapters. The extraordinarily important role that the yellow sector of the spectrum plays in the visual synthesis of colour has been illustrated in those chapters by numerous examples, *viz.*, the colours of flowers, the colours of dyed silks, of natural and synthetic gemstones, as also structural colours of various sorts. One need not therefore be surprised that the reproduction of colour by photographic processes is, in general, only an approximation to the reality.

OBSERVATIONS ON SOME MINERALS AND B VITAMINS IN SEWAGE AND SLUDGES

E. G. SRINATH AND S. C. PHILAI

Department of Biochemistry, Indian Institute of Science, Bangalore-12

INTRODUCTION

SEWAGE contains proteins, fats, carbohydrates, minerals, vitamins and other substances, which make it a suitable medium for the growth and multiplication of micro-organisms, including pathogenic forms. The object of purification of sewage is to eliminate these substances and all pathogens from the medium and to make it as nearly as possible to the original composition of the water used. The work done in different industrial areas of the world over a period of many years to achieve this object has indeed led to practical treatment methods of reasonable efficiency. But it has been increasingly realised that a fuller knowledge of the constituents of sewage and their changes during treatment would be useful not only for a better assessment of the quality of the treated material but also for its better utilization. Attempts are, therefore, being made in different parts of the world to increase the efficiency of the treatment of sewage so that the treated material could be utilized particularly for augmenting the supply of water for agricultural and industrial purposes.^{1,2}

SCOPE OF THE PRESENT INVESTIGATION

There is relatively more information on the nitrogen changes in sewage than on most other constituents of it. In recent years, however, the phosphates in sewage and effluents have attracted special attention because of their influence on excessive growth of algae in the receiving waters.^{3,4} Phosphates in waters have also a close bearing on the growth of enteroviruses⁵ and bacteria such as *Salmonella typhosa*⁶ and *Escherichia coli*.^{6,7} But our knowledge regarding the nature and extent of removal of phosphorus from sewage during treatment by different methods is not satisfactory. The available information on other constituents of sewage and sludges, as on the following, is much less: sulphur,^{8,12} iron,^{9,11,13} calcium,^{9,11,13,16,17} magnesium^{9,13,14,16,17} copper,^{11,14,15,18} zinc,^{11,15,17,19} nickel,^{13,14} chromium,^{14,17} molybdenum,¹⁵ cobalt^{14,16,19,20} and vitamins.^{12,19,21}

The work described here relates mainly to phosphates, sulphates, iron, calcium, magnesium,

copper, zinc, nickel, chromium, molybdenum, cobalt and some B vitamins in sewage and the changes in their amounts during treatment by different methods, including the newly observed system of natural purification of flowing sewage at Bangalore. In view of the presence of cobalt and vitamin B₁₂ in sewage and in view of the fact that cobalt forms an integral part of vitamin B₁₂, further studies on this vitamin in sewage and in sludges formed under different conditions were also carried out.

METHODS EMPLOYED FOR ESTIMATION OF THE MINERALS AND VITAMINS

The available methods for the determination of phosphorus, sulphur, iron, calcium, magnesium, copper, zinc, nickel and chromium were compared, and more suitable methods for sewage, sludges and effluents were selected. Determination of cobalt and molybdenum was carried out by colorimetric methods described by Sandell.²² Phosphorus was determined by the method proposed by Fiske and Subbarow²³ and modified by King.²⁴ The sulphates in sludges were determined by gravimetric method and the sulphates in sewage and effluents were determined by the volumetric method, using benzidine.²⁵ Sulphide, iron, calcium, magnesium, copper, zinc, nickel and chromium were determined by standard methods.^{26-32,33}

The Carr-Price method³⁴ was used for determining vitamin A, and the method using 2,6-dichlorophenol indophenol was adopted for determining ascorbic acid.³⁴ These two vitamins were not detected in sewage, sludge, or effluents. Carotenoids were present in sewage and sludges (determined by colorimetric method³⁴). Thiamine was determined by the thiochrome method.³⁴ Riboflavin was determined by the fluorometric method.³⁴ Niacin was determined colorimetrically by the cyanogen bromide method.³⁴ Vitamin B₁₂ was determined microbiologically,³⁵ using *Lactobacillus leichmannii* A.T.C.C. 4797, *Escherichia coli* 113-3 and *Engelmannia gracilis* as the test organisms. Sewage and sludges were also examined microbiologically for folic acid, biotin and pantothenic acid, using *L. casei*, *L. arabinosus* and *L. plantarum*, respectively, as the test organisms.^{34,36}

manufacturing such glass plates result in extensive areas appearing as cylindrical surfaces of very large radius. If two pieces of such glass, each about five centimetres square, are cut out and their edges are smoothed and the faces are placed in contact with their cylindrical axes in crossed positions, perfect circular interference rings of the Newtonian type on a large scale are produced between the surfaces. These rings exhibit the colour sequence in a very striking fashion and do not need a magnifier for enabling them to be critically examined and studied.

Newtonian interference patterns produced in the manner described above have been photographed, using the white light of a tungsten-filament lamp and with colour-films bearing the well-known name of Kodak, and also with different exposures, in view of the influence which the exposure-time is known to exert on the final picture as seen in the processed film. The very striking result then emerged that the photographed colour-film of the interference pattern does not exhibit the colour sequence in the pattern as seen directly, but differs therefrom in a very conspicuous manner. In seeking for an explanation of these differences, a comparison was made between the features seen in the processed film, and the original patterns as viewed through a piece of neodymium glass, which, as is well known, exerts a powerful absorption in the wavelength range between $570\text{ m}\mu$ and $600\text{ m}\mu$ and thereby effectively excludes the yellow sector of the spectrum, its absorption in the rest of the spectrum being relatively negligible. The interference pattern as seen in white light through the neodymium glass, and the same pattern as recorded on the colour-film without the neodymium filter showed many features in common, and could indeed be described as resembling each other closely.

The facts stated above are evidently of such high significance that it seems desirable to proceed to some further detail. The extremely important role played by the yellow sector of the spectrum in determining the features of the Newtonian interference pattern may be demonstrated in the following manner. The pattern is viewed by reflected light, one half of it as seen with white light, and the other as seen with monochromatic yellow light, *e.g.*, the light of a sodium lamp. The two halves appear in juxtaposition, and there is an astonishingly close coincidence between the two sets of rings. Indeed, the rings as seen with sodium light appear as continuations of the rings seen with white light, the first five minima of illumination

which are conspicuously evident in the white-light pattern appearing in positions indistinguishable from the dark rings of the sodium-light pattern.

As viewed through the neodymium glass, as also in the white-light pattern as photographed on a colour-film, we observe in the first place, that the rings which are visible are far more numerous. Further, the entire field of interferences exhibits alternate regions which are totally different in their observable characters. In one region we find vivid colours, and this is followed by another in which there is a succession of dark and bright rings with no noticeable colour and this again is followed by a region in which colours are distinctly visible. The removal of the yellow sector by the neodymium filter evidently produces these effects on the interference pattern as seen visually. That the same effects are noticeable in the pattern recorded in the colour-film, indicates that the photographic technique employed for recording colour takes no account of the existence of an independent and extremely powerful yellow sector in the spectrum of white light.

Essentially similar differences are also noticed between the interference pattern of a wedge-shaped air-film as observed visually with white light and as photographed in colour with a Kodak film. Likewise, the pattern visible in white light but with a neodymium glass filter interposed shows a remarkably close correspondence with the features noticed in the photographic colour-film record of the white-light pattern. We draw the same inference, *viz.*, that the photographic techniques used for the reproduction of colour fail to take into account the existence of an independent and extremely powerful yellow sector in the spectrum. In other words, they make the mistake of assuming that the yellow of the spectrum is adequately taken care of when it is regarded as a superposition of the green and the red of the spectrum. This, of course, is one of the fundamental errors which vitiates the trichromatic theory of colour, as has already been demonstrated in other ways in earlier chapters. The extraordinarily important role that the yellow sector of the spectrum plays in the visual synthesis of colour has been illustrated in those chapters by numerous examples, *viz.*, the colours of flowers, the colours of dyed silks, of natural and synthetic gemstones, as also structural colours of various sorts. One need not therefore be surprised that the reproduction of colour by photographic processes is, in general, only an approximation to the reality.

OBSERVATIONS ON SOME MINERALS AND B VITAMINS IN SEWAGE AND SLUDGES

E. G. SRINATH AND S. C. PILLAI

Department of Biochemistry, Indian Institute of Science, Bangalore-12

INTRODUCTION

SEWAGE contains proteins, fats, carbohydrates, minerals, vitamins and other substances, which make it a suitable medium for the growth and multiplication of micro-organisms, including pathogenic forms. The object of purification of sewage is to eliminate these substances and all pathogens from the medium and to make it as nearly as possible to the original composition of the water used. The work done in different industrial areas of the world over a period of many years to achieve this object has indeed led to practical treatment methods of reasonable efficiency. But it has been increasingly realised that a fuller knowledge of the constituents of sewage and their changes during treatment would be useful not only for a better assessment of the quality of the treated material but also for its better utilization. Attempts are, therefore, being made in different parts of the world to increase the efficiency of the treatment of sewage so that the treated material could be utilized particularly for augmenting the supply of water for agricultural and industrial purposes.^{1,2}

SCOPE OF THE PRESENT INVESTIGATION

There is relatively more information on the nitrogen changes in sewage than on most other constituents of it. In recent years, however, the phosphates in sewage and effluents have attracted special attention because of their influence on excessive growth of algae in the receiving waters.³⁻⁵ Phosphates in waters have also a close bearing on the growth of enteroviruses⁶ and bacteria such as *Salmonella typhosa*⁷ and *Escherichia coli*.^{8,9} But our knowledge regarding the nature and extent of removal of phosphorus from sewage during treatment by different methods is not satisfactory. The available information on other constituents of sewage and sludges, as on the following, is much less: sulphur,^{9,12} iron,^{9,13,17} calcium,^{9,13,14,16,17} magnesium,^{9,13,14,16,17} copper,^{13,15,17,18} zinc,^{13,15,17,18} nickel,^{13,17} chromium,^{14,17} molybdenum,¹⁸ cobalt^{11,16,18,19} and vitamins.^{12-19,28}

The work described here relates mainly to phosphates, sulphates, iron, calcium, magnesium,

copper, zinc, nickel, chromium, molybdenum, cobalt and some B vitamins in sewage and the changes in their amounts during treatment by different methods, including the newly observed system of natural purification of flowing sewage at Bangalore. In view of the presence of cobalt and vitamin B₁₂ in sewage and in view of the fact that cobalt forms an integral part of vitamin B₁₂, further studies on this vitamin in sewage and in sludges formed under different conditions were also carried out.

METHODS EMPLOYED FOR ESTIMATION OF THE MINERALS AND VITAMINS

The available methods for the determination of phosphorus, sulphur, iron, calcium, magnesium, copper, zinc, nickel and chromium were compared, and more suitable methods for sewage, sludges and effluents were selected. Determination of cobalt and molybdenum was carried out by colorimetric methods described by Sandell.²⁰ Phosphorus was determined by the method proposed by Fiske and Subbarow²⁰ and modified by King.²¹ The sulphates in sludges were determined by gravimetric method and the sulphates in sewage and effluents were determined by the volumetric method, using benzidine.²² Sulphide, iron, calcium, magnesium, copper, zinc, nickel and chromium were determined by standard methods.^{23-32,33}

The Carr-Price method³⁴ was used for determining vitamin A, and the method using 2,6-dichlorophenol indophenol was adopted for determining ascorbic acid.³⁴ These two vitamins were not detected in sewage, sludge, or effluents. Carotenoids were present in sewage and sludges (determined by colorimetric method³⁴). Thiamine was determined by the thiochrome method.³⁴ Riboflavin was determined by the fluorometric method.³⁴ Niacin was determined colorimetrically by the cyanogen bromide method.³⁴ Vitamin B₁₂ was determined microbiologically,³⁵ using *Lactobacillus leichmannii* A.T.C.C. 4797, *Escherichia coli* 113-3 and *Euglena gracilis* as the test organisms. Sewage and sludges were also examined microbiologically for folic acid, biotin and pantothenic acid, using *L. casei*, *L. arabinosus* and *L. plantarum*, respectively, as the test organisms.^{34,36}

MINERALS AND B VITAMINS IN SEWAGE AND SLUDGES

Periodical analysis was carried out on (a) samples of domestic sewage from the sewage works at this Institute and from the natural sewage channels at Bangalore, (b) samples of sludges and effluents from the activated sludge plant and the septic tanks at this Institute, and (c) samples of sludges and effluents from treatments carried out under laboratory conditions. One set of results obtained under laboratory conditions are given in Tables I and II.

TABLE I

Results of analysis of sewage and effluents
(Average, expressed as mg./l.)

	Number of samples examined	Raw sewage*	Effluent from	
			Anaerobic treatment†	Aerobic treatment†
Phosphorus (P):				
Water-soluble	1658	7.5	7.5	1.2
Total	1658	11.1	10.7	1.7
Sulphate (SO ₄)	178	57	41	55
Sulphide (S)	178	2	14	Nil
Iron (Fe)	105	10.1	7.2	2.9
Calcium (Ca)	102	45.3	36.3	37.5
Magnesium (Mg)	102	52.3	43.8	41.9

* The maximum amounts of copper, zinc, nickel and cobalt in the raw sewage were 0.05, 0.05, 0.01 and 0.8 mg./l. respectively. Only trace amounts of chromium and molybdenum were found in the sewage.

† These results of analysis of the effluents from treatments under laboratory conditions were similar to those from the septic tanks and the activated sludge plant, respectively, at the Institute. The effluents from both the treatments contained traces of copper, zinc, nickel, chromium and molybdenum.

Sewage and Sludges.—Raw sewage contains appreciable amounts notably of phosphates, sulphates, calcium, magnesium and iron. During treatment by the activated sludge process the sludge removed a large part of the phosphorus (about 90%) and iron (about 70%) from the sewage, leaving only small amounts of them in the effluent. In this process the sulphates were not removed to any considerable extent from the sewage. The percentage removal of calcium and magnesium in this process did not exceed 21.

Sewage also contains small amounts or traces of cobalt, copper, zinc, nickel, chromium, and molybdenum, and these were removed nearly completely by activated sludge and by septic tank sludge, and the effluents from these treatments generally showed only traces of these elements.

There are vital differences between these two sludges. While activated sludge contained only a trace amount of sulphide, the septic tank

sludge contained a considerable amount of sulphide. The septic tank sludge, as compared to activated sludge, contained much less sulphates and phosphates.

The observations given in Table II also indicate that activated sludge contains relatively

TABLE II

Results of analysis of sewage and sludges
(Average of six analyses)

	Raw sewage solids	Sludge from	
		Anaerobic treatment	Aerobic treatment
<i>Minerals (mg./100 g. of dry solids) :</i>			
Phosphorus (P)	.. 500	680	1870
Sulphate (SO ₄)	.. 950	710	1800
Sulphide (S)	.. Trace	180	Trace
Iron (Fe)	.. 500	680	880
Calcium (Ca)	.. 1510	1700	1600
Magnesium (Mg)	.. 1600	2150	1900
Copper (Cu)	.. 4.0	50	50
Zinc (Zn)	.. 4.3	52	58
Chromium (Cr)	.. Trace	3.4	3.4
Nickel (Ni)	.. "	2.6	2.6
Molybdenum (Mo)	.. "	4.8	5.5
Cobalt (Co)	.. 30	95	98

Vitamins (mcg./100 g. of dry solids):

Thiamine	580	650	800
Riboflavin	490	670	980
Niacin	2700	3200	4100
Vitamin B ₁₂	16.4	9.6	75.4

Folic acid, pantothenic acid and biotin were present in the sewage and sludges. Quantitative assay of these vitamins was not carried out.

The above results of analysis of the sludges from treatments under laboratory conditions were similar to those from the septic tanks and the activated sludge plant, respectively, except with regard to riboflavin which was comparatively less in the corresponding latter sludges.

more thiamine, riboflavin, niacin and vitamin B₁₂ than in sewage or in the sludge formed under anaerobic conditions. The amounts of these vitamins in activated sludge are comparable to the vitamin contents of liver, chicken, pork, bacon, sardines and salmon.³⁷ Activated sludge has been considered as one of the richest sources of vitamin B₁₂.²⁶

Mention may be made of the earlier observation that pathogenic bacteria causing typhoid, cholera and dysentery are eliminated from sewage during purification by activated sludge process.³⁸ Some observations have recently been made on the use of activated sludge as a fertilizer for fish culture,³⁹ and more recent experiments at Bangalore have shown that the sludge could be used as a feed supplement for poultry.

Effluents. The effluent from activated sludge process, was practically free from sulphide. The effluent from anaerobic or septic tank treatment contained practically all the water-soluble phosphorus originally present in the sewage.

With regard to the other minerals studied, the effluents from the activated sludge process and anaerobic treatment were comparable except for iron which was considerably more in the effluent from the latter treatment.

FURTHER OBSERVATIONS

Studies were also carried out on the extent of removal of the minerals from sewage during sedimentation, dilution with water in different proportions, chemical coagulation, filtration through granite chips of 1.2 inch size, sand and sand fractions of varying size¹⁰ and during natural purification of flowing sewage at Bangalore.¹¹ During sedimentation and dilution of sewage, the mineral composition of the samples was not appreciably affected. The supernatant liquids from sewage samples coagulated with lime, alum and ferric chloride did not show any phosphate, but they showed the presence of the other minerals in varying amounts. Lime removed the maximum percentage (about 90) of the iron and nearly all the copper, zinc, nickel, chromium, cobalt and molybdenum.

Experiments with the filters indicated that the reduction or removal of the minerals is largely a chemical process in the early stages of the operation of the filters and that it is largely a biological process (except iron) in the later stages after the ripening of the filters. Similar changes were observed during purification of the sewage flowing down in natural channels at Bangalore.

Further experiments with activated sludge were also carried out by adding varying concentrations of chemicals such as mercuric chloride, zinc sulphate, copper sulphate, nickel sulphate, potassium chromate, sodium molybdate and cobalt sulphate. An observation of considerable interest and importance was the influence of an optimum concentration of cobalt on the enrichment of activated sludge vitamin B₁₂.¹²

CONCLUSION

The method of disposal or treatment of sewage to be chosen for a given place depends upon several factors, e.g., the availability of land space, nearness to a watercourse and economic aspect. At the same time the proposed method should fulfil the requirements of environmental hygiene and sanitation.

The different methods of sewage treatment differ in their efficiency which is reflected in the final products. The liquid and solids from the activated sludge process show a high degree of purification. The sludge in this system removes from sewage most of the organic and mineral constituents to give rise to a clear effluent which could be safely used in agriculture or, after further treatment, in certain industries. The sludge thus produced is rich in proteins, minerals and B vitamins, notably vitamin B₁₂. It may be utilized as a fish feed or as a feed supplement for farm animals, such as chicks, in addition to its use as an excellent organic manure.

1. Bolton, R. L. and Klein, L., *Sewage Treatment: Basic Principles and Trends*, Butterworths, London, 1961, p. 111.
2. Eliassen, R., *J. Wat. Pollut. Contr. Fed.*, 1963, **35**, 267.
3. Sawyer, C. N., *Ibid.*, 1962, **34**, 279.
4. Srinath, E. G. and Pillai, S. C., *Sewage*, Seventh Annual Meet. of Public Health Engineers, West Bengal, 1964, (F) - (1).
5. Kelley, S., Sanderson, W. W. and Neidil, C., *J. Wat. Pollut. Contr. Fed.*, 1961, **33**, 1056.
6. Gabbiano, L., *Igiene di S.*, 1928, **24**, 238; *W.P.A. Summary*, 1930, **3**, Abstr. No. 557.
7. McCarthy, L. A. and Cassidy, W. E., *J.N.E. Wat. Wks. Assn.*, 1943, **57**, 287.
8. Weston, A. D., *Amer. City*, 1944, **58**, 0.
9. Rideal, S., *Sewage and the Bacterial Purification of Sewage*, The Sanitary Publishing Co., Ltd., London, 1906, p. 167.
10. Henkelekian, H., *Bull. N.J. Agric. Expt. Res. Sta.*, 1930, Bull. No. 502.
11. Mahle, W., *Sewage Wks. J.*, 1934, **6**, 547.
12. Knivett, V. A., *Progress in Industrial Microbiology*, Heywood & Co. Ltd., London, 1960, **2**, 27.
13. Watanabe, M., *Mitt. Med. Acad. Kyoto*, 1940, **30**, 861.
14. Rudolfs, W. and Gehm, H. W., *Bull. N.J. Agric. Expt. Sta.*, 1947, Bull. No. 690.
15. Stone, T., *J. and Proc. Ind. Sew. Purif.*, 1966, Part 1, 346; 1966, Part 4, 349, 404; 1968, Part 1, 82; 1969, Part 2, 262, 264.
16. Matsuyama, S., *Igaku Kugyaku*, 1960, **30**, 2791.
17. Painter, H. A., *Water Waste Treatm. J.*, 1958, **6**, 496.
18. Clark, L. J. and Hill, W. L., *I.L.O.I.C.*, 1958, **41**, 631.
19. Rao, S. S. and Srinath, E. G., *Naturwissenschaften*, 1960, **47**, 518.
20. Rudolfs, W. and Heinemann, B., *Sewage Wks. J.*, 1939, **11**, 587.
21. Hoover, S. R., Josewicz, L. E. and Foiges, N., *Science*, 1961, **114**, 213.
22. Kocher, V. and Corti, U. A., *Schweiz. J. Hydrol.*, 1952, **14**, 333.
23. Neujahr, H. Y., *Acta Chem. Scand.*, 1955, **9**, 622.
24. Kiké, M., *Vitamins* (Japan), 1966, **10**, 133.
25. Kamikubo, T., *J. Vitamins* (Osaka), 1957, **3**, 172.
26. White, A., Handler, P., Smith, E. L. and DeWitt Stetten, *Principles of Biochemistry*, McGraw-Hill Book Company Inc., New York, 1959, p. 1019.
27. Rao, S. S., Sastri, C. A., Bhagawan, H. N. and Baliga, B. R., *Science*, 1959, **129**, 276.

28. Rao, R. S. and Pillai, S. C., *J. sci. industr. Res.*, 1962, **21 A**, 33.
29. Sandell, E. B., *Colorimetric Determination of Traces of Metals*, Interscience Publishers Inc., New York, 2nd Ed., 1950, pp. 271, 455.
30. Fiske, C. H. and Subbarow, Y., *J. biol. Chem.*, 1925, **66**, 375.
31. King, E. J., *Biochem. J.*, 1932, **26**, 192.
32. Theroux, F. R., Eldridge, E. F. and Mallmann, W. L., *Laboratory Manual for Chemical and Bacterial Analysis of Water and Sewage*, McGraw-Hill Book Company Inc., New York, 1943, pp. 14, 18.
33. *Standard Methods for the Examination of Water and Waste Water*, American Public Health Association, New York, 11th Ed., 1960, pp. 64, 67, 117, 151, 366, 386, 387.
34. *Official Methods of Analysis*, Association of Official Agricultural Chemists, Washington D.C., 1960, Pp. 652, 654, 655, 658, 660.
35. Glick, D., *Methods of Biochemical Analysis*, Interscience Publishers Inc., New York, 1954, **1**, 81.
36. Gyorgyi, P., *Vitamin Methods*, Vol. I, Academic Press Inc., New York, 1950, p. 332.
37. *Manual of Nutrition*, H. M. Stationery Office, London, 1961, pp. 69-70.
38. Pillai, S. C., Gurbaxani, M. I. and Menon, K. P., *Indian Med. Gaz.*, 1952, **87**, 117.
39. Gopalakrishnan, V. and Srinath, E. G., *Proc. Indian Acad. Sci.*, 1963, **57 B**, 379.
40. Srinath, E. G., Sastry, C. A. and Pillai, S. C., *J. sci. industr. Res.*, 1962, **21 C**, 220.
41. —, Rao, S. S. and Pillai, S. C., *Ibid.*, 1962, **21 C**, 258.

MORPHOLOGICAL AND ANATOMICAL STUDIES IN HELOBIÆ

X. Trends of Specialization in Placentation in Helobiæ*

V. SINGH

School of Plant Morphology, Meerut College, Meerut

THE name Helobiæ was first used by Engler and Prantl¹ for a group of families including Potamogetonaceæ, Najadaceæ, Aponogetonaceæ, Scheuchzeriaceæ, Alismaceæ, Butomaceæ and Hydrocharitaceæ. The seven families of the order are placed together chiefly on account of their aquatic habitat, presence of squamulæ intravaginales within the leaf bases, more or less complete absence of endosperm in seed, and enlarged embryo. However, the floral structures which are considered to be most conservative do not show any marked similarity. The vascular pattern of the flower and placentation also show a great variation.²⁻¹⁴ The present study deals with some probable trends of specialization in placentation in the Helobiæ.

A wide range in placentation has been observed in different families of the order. They show median and apical (Potamogetonaceæ), basal (Najadaceæ, Scheuchzeriaceæ, Alismaceæ); marginal and axile (Aponogetonaceæ); laminar or superficial (Butomaceæ); and parietal (Hydrocharitaceæ) placentation.

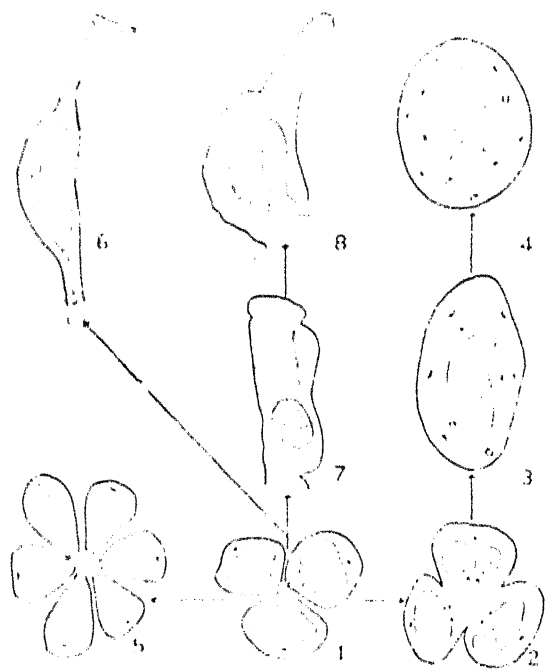
The marginal placentation is considered to be the simplest by the supporters of the classical concept (see Puri, 1952).⁵ This is the condition in monomerous gynacea, which are generally believed to be most primitive and is shown by the primitive ranalian families where carpel is an involutely folded structure. Amongst Helobiæ this condition is met with in the Aponogetonaceæ where the carpels are free in the upper region and open in young condition like those of the primitive ranalian families. Each carpel

bears two marginal rows of ovules and has a vascular supply of three bundles, one dorsal and two carpellary ventrals (Fig. 1). It has been visualized that the marginal placentation is the basic condition for the Helobiæ and the evolution seems to have progressed from this condition along three different lines leading to axile, superficial and basal placentation. Further specialisation in axile placentation has resulted in parietal placentation.

In one line of specialization the marginal placentation has given rise to axile placentation. This is seen in *Aponogeton* where the carpels though free are basally and adaxially connate. In the basal region the ovary is distinctly chambered, the two half placentæ are borne on the fused margins of the same carpel and derive their vascular supply from the ventrals of the same carpel (Fig. 2). Further the ventral bundles lie on the same radii as the carpellary dorsals and are inversely oriented. Thus the fusion of the carpels bearing ovules at their margins have resulted in axile placentation.

Further specialization towards parietal placentation which is prevalent in *Hydrocharitaceæ* has been brought about from axile placentation by more and more receding of placentæ towards the periphery so that the ventral bundles and their placentæ have occupied the peripheral position. The ventral bundles of the two adjacent carpels have also fused among themselves to form the vascular supply of parietal placentæ (Fig. 3). It may be pointed out here that in a number of families parietal

placentation is believed to be derived from axile placentation.^{4,5}



FIGS. 1-8. Showing trends of specialization in placentation in Helobia. Figs. 1, 2. Cross-sections of ovary of *Apocynum* from upper and basal regions respectively. Figs. 3, 4. Cross-section of ovaries of *Zannichellia*, *Ottelia* respectively and *Butomus umbellatus* respectively. Figs. 5, 6, 7, 8. Longitudinal sections of carpels of *Zannichellia peltata*, *Potamogeton indicus* and *Sagittaria arifolia* respectively.

In certain members of the family Hydrocharitaceae such as *Hydrocharis*, *Ottelia*, *Euhalsia*, etc., the condition becomes rather interesting in that the ovary is incompletely divided into chambers and most of the inner surface of the ovary wall, except along the dorsal line, is covered with ovules. (Fig. 4). This is sometimes described as lammar placentation.¹ However, Puri² explains similar condition in some members of Rafflesiaceae and Papaveraceae that in such cases the placenta enlarge considerably and project towards the centre, there are apparently no true septa but merely placental lamellae and thus he described the placentation as parietal. Such a condition occurring in certain members of Hydrocharitaceae seems to have been derived from normal parietal placentation prevalent in majority of members of the family.

In the second line of specialization the marginal placentation has resulted in superficial placentation which is seen in Butomaceae, where the ovules appear to arise from most of the ventral surface except the dorsal suture (Fig. 5).

This condition might have resulted by the excessive enlargement of the fertile ventral surface of the carpellary margins which bears ovules.⁶ The rest of the ventral surface become suppressed except in the neighbourhood of midrib. This view gets support from the condition seen in some species of *Gentiana* where the two halves of a parietal placenta separate apart from each other due to the extension of the intervening regions of the carpellary margins and thus bringing about the superficial placentation.⁴

Specialization along a third line has resulted in median, apical and basal placentation prevalent in Potamogetonaceae, Najadaceae, Scheuchzeriaceae and Alismaceae. In the course of evolution probably all the ovules present on margins of carpels got lost except for the one. This suppression may be in either direction up or down. If the surviving ovule was a distal member then a condition similar to *Zannichellia* (apical placentation) has resulted (Fig. 6). If the lowest ovule survived, then a condition which is seen in some Potamogetonaceae like *Potamogeton* and *Ruppia* (median placentation) has resulted (Fig. 7). Further shifting down of the ovule into the base of the ovary resulted in the basal placentation (Fig. 8). Eber⁷ also considers that the basal condition of the ovule of *Najas* is derived from the condition in Potamogetonaceae. The Alismaceae also show in *Damasium* a series of stages in reduction from marginal to basal placentation: *D. polyspermum* has several ovules; *D. stellatum* two ovules; and *D. californicum* a solitary ovule.¹ Thus in these cases the basal placentation has resulted from marginal placentation by reduction in vascular supply of the carpel and loss in number of ovules.

The author is grateful to Dr. Y. S. Murty for guidance and to Professor V. Puri for critically going through the manuscript and making valuable suggestions.

1. James A. L., *Morphology of Angiosperms*, New York, 1961.
2. Eber, Von Erna, *Flora*, **127**, 273.
3. Engler, A. and Prantl, K., *Die natürlichen Pflanzenfamilien* 11, Leipzig, 1889.
4. Gopal Krishna, G. and Puri, V., *Botan. Gaz.*, 1962, **124**, 12.
5. Puri, V., *Bot. Rev.*, 1952, **18**, 603.
6. -, *Proceedings Summer School of Botany, Lucknow* (1960), 1962, p. 326.
7. Singh, V., *Botan. Gaz.*, 1965, **126**, 137.
8. -, *Proc. Ind. Acad. Sci.*, 1965, **61**, 98.
9. -, *Ibid.*, 1965, **61**, 147.
10. -, *Ibid.*, 1965, **61**, 316.
11. -, *Ibid.*, (in press).
12. -, *Proc. Nat. Acad. Sci.*, (in press).
13. -, *Agra Univ. Journ. Res.*, (in press).
14. -, *Ibid.*, (in press).

LETTERS TO THE EDITOR

ZEEMAN EFFECT OF BROMINE NQR
IN *p*-BROMOANILINE

LUDWIG¹ reported Br⁷⁹ resonance frequency as 262.17 Mc./sec. at room temperature and Bray and Barnes² reported Br⁸¹ frequency at liquid nitrogen temperature as 221.86 Mc./sec. in *p*-bromoaniline. Our experiments at room temperature on this compound yielded resonance frequencies of 262.23 Mc./sec. and 219.17 Mc./sec. for Br⁷⁹ and Br⁸¹ respectively. The resonances are intense and can be seen on the oscilloscope.

For studying the Zeeman effect in *p*-bromoaniline, large single crystals were grown from solution and cylindrical crystals were grown from melt. According to Groth³ the crystal belongs to the rhombic bipyramidal class with axial ratios:

$$a : b : c = 0.9046 : 1 : 0.8100.$$

No x-ray data are available for this crystal.

Minematsu⁴ investigated nitrogen quadrupole resonance using cylindrical crystals and she also made preliminary investigation on Br⁸¹ resonance.

A detailed Zeeman effect study of Br⁷⁹ and Br⁸¹ carried out by us on crystals with faces and rotating the crystal about *a*, *b* and *c* axes has shown that the growth axis of the cylindrical crystal is nearly parallel to '*a*' axis. This result is in agreement with Minematsu's observations and also with the observations of Mcal⁵ on the iso-structural *p*-chloroaniline. Our investigations show that

(1) there are two inequivalent directions for the C-Br bond and (2) these two directions are separated by 76°-78°.

The asymmetry parameter obtained by refining the zero splitting locus is 0.08 ± 0.02 for both the inequivalent bonds. This gives the single bond character of 77.4%, ionic character 19.7% and double bond character 2.9%. Full details will be published shortly.

The authors are indebted to Prof. K. R. Rao and Dr. D. Premaswarup for their kind interest and encouragement and one of us (K. V. S.) is grateful to the C.S.I.R. for the financial assistance.

Magnetic Resonance Lab., K. V. S. RAMA RAO.
Physics Department, C. R. K. MURTY.
Andhra University,
Waltair, March 12, 1966.

1. Ludwig, G. W., *J. Chem. Phys.*, 1956, **25**, 159.
2. Bray, P. J. and Barnes, R. G., *Ibid.*, 1954, **22**, 2023.
3. Groth, P., *Chemische Krystallographie*, Verlag von Wilhelm Englemann, 1917.
4. Minematsu, M., *J. Phys. Soc. Japan*, 1959, **14**, 1030.
5. Mcal, H. C., *J. Chem. Phys.*, 1956, **24**, 1011.

SYNTHESIS OF WIGHTIN

WIGHTIN is a new flavone isolated from the stems and the roots of the Indian herb *Andrographis wightiana* (Family: Acanthaceae).¹ On the basis of the colour reactions, spectral data and degradative evidence it was assigned the structure 5, 3'-dihydroxy-7, 8, 2'-trimethoxy flavone and this was confirmed by the synthesis of its dimethyl and diethyl ethers. In continuation of our studies on 2'-oxygenated flavonoids² we have now synthesized wightin itself, the only naturally occurring flavone with the unique 2', 3'-oxygenation pattern.

2-Methoxy-3-benzyloxy benzoic acid required for this synthesis was prepared by the partial benzylation of 2, 3-dihydroxy benzoic acid to 3-benzyloxy salicylic acid, followed by methylation and subsequent hydrolysis of the resulting ester. Condensation of the chloride of this acid with 2-hydroxy-3, 4, 6-trimethoxy acetophenone gave the ester, 2-(2-methoxy-3-benzyloxy benzoyloxy)-3, 4, 6-trimethoxy acetophenone which, by the usual methods, was isomerised to the dibenzoylmethane and then converted into 5, 7, 8, 2'-tetramethoxy-3'-benzyloxy flavone. Debenzylation of the latter yielded 5, 7, 8, 2'-tetramethoxy-3'-hydroxy flavone (5-O-methyl wightin) which on partial demethylation with aluminium chloride in acetonitrile solution furnished wightin. After purification by TLC (silica gel) it was identical with the natural sample in m.p. and m.m.p., ferric reaction, U.V. and I.R. spectra; further confirmation was provided by TLC cochromatography and preparation of the acetate (m.p. and m.m.p.). Demethylation of wightin (or 5-O-methyl wightin) with aluminium chloride in benzene solution gave norwightin (5, 7, 8, 2', 3'-pentahydroxy flavone) which was also characterised as its acetate.

The authors wish to express their grateful thanks to Prof. T. R. Govindachari for the supply of natural wightin, I.R. spectra and n.m.p. determinations and to Prof. B. R. Pai for samples of natural wightin and its acetate. Department of Chemistry, S. C. DATTA, Delhi University, V. V. S. MURTI, Delhi 7, May 3, 1966 T. R. SESHADRI.

1. Govindachari, T. R., Parthasarathy, P. C., Pai, B. R. and Subramaniam, P. S., *Polymer*, 1965, **21**, 3237.
2. Murti, V. V. S., Raman, P. V. and Seshadri, T. R., *Chem. Rev.*, 1965, **34**, 398.

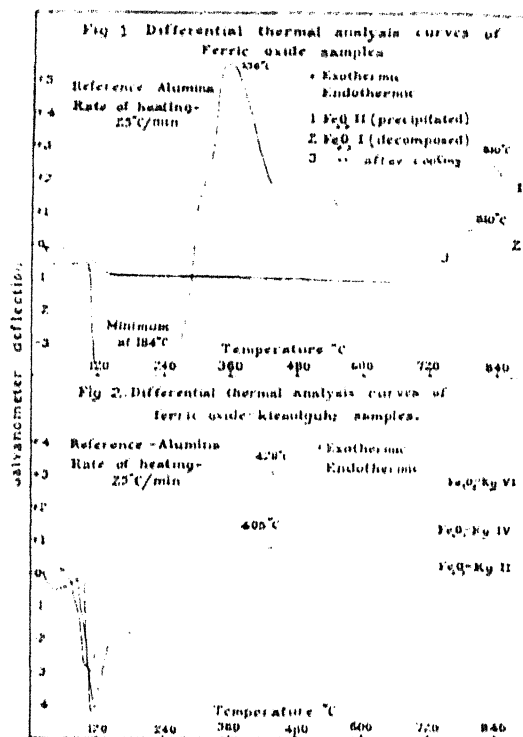
DIFFERENTIAL THERMAL ANALYSIS OF UNSUPPORTED AND SUPPORTED IRON OXIDE CATALYSTS*

In recent years, the technique of Differential Thermal Analysis (DTA) has been employed as a tool in the structural studies of catalysts of technical importance.¹ To characterize some of the nickel hydrosilicates formed during the preparation of nickel-silica catalysts, Voorthuysen and Franzen² used this technique as an adjunct to the well-established X-ray diffraction method.³ In the present investigation, the same technique has been extended to understand the thermal behaviour of some unreduced iron catalysts.

The apparatus employed for the determination of thermal analysis curves was essentially the same as described by Bhattacharya and co-workers.¹ The following samples have been studied:

1. Fe_2O_3 I, prepared by the decomposition of pure hydrated ferric nitrate at 400°C.
2. Fe_2O_3 II, prepared by the precipitation of ferric nitrate as hydroxide in solution by ammonia followed by drying of the precipitate at 110°C. for several hours.
3. Fe_2O_3 -Kg II, prepared by the precipitation of ferric nitrate as hydroxide by ammonia in a slurry of Kieselguhr (with surface area of 44 m² per gram) followed by drying of the precipitate at 110°C. for several hours.
4. Fe_2O_3 -Kg VI, prepared by the same method as Fe_2O_3 -Kg II, but in presence of Kieselguhr (with surface area of 1.5 m² per gram).
5. Fe_2O_3 -Kg IV, prepared by mixing a slurry of Kieselguhr (with surface area of 44 m² per gram) with a slurry of ferric hydroxide obtained by precipitation from ferric nitrate, followed by drying of the precipitate, at 110°C. for several hours.

The differential thermal analysis curves for the above samples obtained using chromel-alumel thermocouples with a rate of heating of 25°C. per minute, are shown in Figs. 1 and 2.



FIGS. 1 & 2

The DTA curve of Fe_2O_3 I showed an exothermic reaction beginning at 680°C. reaching a maximum at 810°C. To test the reversibility of this reaction, the sample was cooled to room temperature and the experiment repeated. The exothermic reaction was again reproduced. The thermocouples were found unattacked even after repeated runs.

Fe_2O_3 II on heating undergoes several structural changes as revealed by several peaks in the DTA curve. The endothermic peak at 184°C. is ascribed to the expulsion of adsorbed water from the ferric oxide gel accompanied by the formation of amorphous Fe_2O_3 . The crystallisation of this amorphous Fe_2O_3 to α - Fe_2O_3 takes place around 250° to 450°C. as indicated by the exothermic peak at 356°C. Bhattacharya and co-workers¹ who prepared ferric oxide gel by a similar method noticed a low temperature endothermic reaction between 140-200°C. due to the expulsion of adsorbed

water followed by an exothermic reaction between 360° and 465° C. due to crystallization of $\alpha\text{-Fe}_2\text{O}_3$ and these results were confirmed by X-ray diffraction studies. Lodling and Hammell⁴ who have also studied the thermal behaviour of aged ferric oxide gels employing DTA and X-ray techniques, have reported the formation of goethite ($\alpha\text{-FeO.OH}$) and also small amount of lepidocrocite ($\gamma\text{-FeO.OH}$) in the initial stages.

During the preparation of Fe_2O_3 II employed in the present investigation, the ferric hydroxide was not allowed to age, so that the formation of $\alpha\text{-FeO.OH}$ could not be expected. It is, however, possible to expect the formation of traces of $\gamma\text{-Fe}_2\text{O}_3$ along with $\alpha\text{-Fe}_2\text{O}_3$. The small exothermic peak noticed around 540° C. may be due to the conversion of $\gamma\text{-Fe}_2\text{O}_3$ to $\alpha\text{-Fe}_2\text{O}_3$ as reported by Lodling and Hammell. There is no reference in literature for the occurrence of an exothermic reaction for Fe_2O_3 samples prepared by diverse methods around 800° C. Further work is in progress to characterise the reversible exothermic reaction at 810° C.

The DTA curves of the supported ferric oxide samples show a single endothermic peak around 110° C. due to expulsion of adsorbed water and an exothermic peak around 400–430° C. due to the crystallization of amorphous Fe_2O_3 . Comparison of the DTA curves of unsupported and supported ferric oxide samples shows that the introduction of Kieselguhr as support results in the suppression of peaks obtained at 540° C. and 810° C., which can possibly be ascribed to the relatively small amount of Fe_2O_3 (about 20–30% of the total weight) in the samples. The introduction of support facilitates the easy removal of adsorbed water as seen by the shifting of the endothermic peak from 184° C. to around 110° C., but does not help the crystallization of amorphous Fe_2O_3 (because of the dispersion of the oxide on the surface of the support) which is indicated by the shift of the exothermic peak from 356° C. to a higher temperature (400–430° C.). The absence of a second endothermic peak in the DTA curves of $\text{Fe}_2\text{O}_3\text{-Kg}$ samples is indicative of the absence of iron hydrosilicates in them.

The author expresses his gratitude to Prof. M. R. A. Rao, Department of Inorganic and Physical Chemistry, Indian Institute of Science, Bangalore, for his guidance.

Department of Chemistry,
Indian Institute of Technology,
Madras-36, December 23, 1965.

C. S. SWAMY.

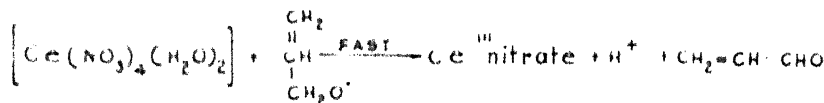
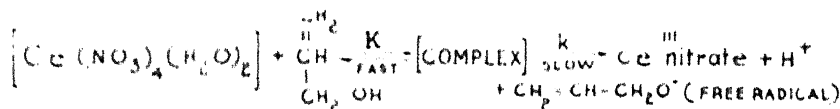
* Work carried out at the Department of Inorganic and Physical Chemistry, Indian Institute of Science, Bangalore-12.

1. Bhattacharya and Ganguly, B., *Proc. Natl. Inst. Sci., India*, 1962, **27 A**, 588.
2. Voorthuijsen and Franzen, *Rec. Trav. Chem.*, 1951, **70**, 793.
3. De Lange and Visser, *Ingenieur*, 1946, **58**, 24.
4. Lodling and Hammell, *Anal. Chem.*, 1960, **32**, 657.

KINETICS OF OXIDATION OF ALLYL ALCOHOL BY CERIC NITRATE IN NITRIC ACID

The oxidation of alcohols by ceric salts has attracted the attention of many workers in recent years.¹⁻⁴ The work has been concentrated chiefly on the oxidation of various alcohols by ceric perchlorate in perchloric acid or ceric sulphate in sulphuric acid. Not much work has been done using ceric nitrate in nitric acid. The two outstanding papers in this field are the one by Duke and Forist⁵ on the oxidation of 2, 3-butanediol by ceric nitrate, and the other by Shorter⁶ on the oxidation of acetone. In our earlier paper⁷ the results on the oxidation of isopropanol and sec. butanol, by ceric nitrate in nitric acid, were presented and discussed. In this paper, the results on the oxidation of allyl alcohol by ceric nitrate in nitric acid are presented. In general, reactions in this medium resemble those in perchloric acid. The oxidation of allyl alcohol by ceric nitrate was found to be faster as compared to *n*-propanol.

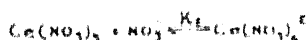
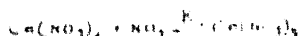
The reaction has been followed by determining the rate of ceric disappearance by titrimetry with excess of ferrous ions and back titration with standard ceric ammonium sulphate using methyl red as the indicator. The rate is first order with respect to cerium (*iv*) in the initial stages of the reaction. The pseudo unimolecular rate constants obtained under the conditions of allyl alcohol $\gg \text{Ce}(\text{iv})$ gives an order of 0.72 for allyl alcohol. The plot of $1/\text{Rate}$ Vs. $1/[\text{Allyl alcohol}]$ was found to be linear. The rate was found to increase with decrease in H^+ -ion concentration at constant ionic strength, and inversely as the square of the nitrate-ion concentration. The results in the present investigation are similar to the results of our earlier work⁷ on the isopropanol oxidation. There is both kinetic and spectrophotometric (cf. Ardon²) evidence to show that a 1 : 1 complex is formed between ceric nitrate and allyl alcohol before fission of the O-H bond and electron transfer. The mechanism seems to be as follows :



Aerobium being very susceptible to oxidation may react with cerium (IV) at later stages of the reaction thereby complicating the whole process. This is one of the reasons why this study has been restricted to the initial stages of the reaction only. If the above mechanism is considered, the rate equation takes the form

$$- \frac{d[\text{Ce}(\text{IV})]}{dt} = \frac{k K [\text{aer}]}{K_1 K_2 [\text{NO}_3]^2 [1 + K [\text{ROH}]} \quad (1)$$

where k = disproportionation constant, K = the equilibrium constant of the complex, $[\text{ROH}]$ = the concentration of allyl alcohol and K_1 and K_2 are the equilibrium constants of the following equilibria:



The left-hand side of equation (1) refers to the observed pseudo unimolecular rate constant k' . The above rate equation may be rewritten as

$$\frac{1}{k'} = \frac{K_1 K_2 [\text{ROH}]^2}{k K} + \frac{K_1 K_2 [\text{NO}_3]^2}{k}$$

Equation (2) predicts that a plot of $1/k'$ vs. $1/[\text{ROH}]$ should be a straight line with an intercept, which has been observed in our work. From the slope and intercept values the formation constant of the complex K has been evaluated. From the values of K at different temperatures, the heat of formation and other thermodynamic constants have been calculated. The values are given in Table I.

TABLE I

Property Value

k at 20 °C.	..	3.077 lit. mol. ⁻¹
H	..	10.37 K cal. mol. ⁻¹
G	..	-664.3 cal. mol. ⁻¹
S	..	-33.16 e.u.

The author wishes to express his sincere thanks to Prof. N. V. Subba Rao for his constant encouragement and to the Government of India for the Senior Research Training Scholarship.

Physico-chemical Lab., B. SETHURAM,
Department of Chemistry,
Osmania University,
Hyderabad-7, November 29, 1965.

1. Duke, F. R. and Bremer, R. E., *J. Am. Chem. Soc.*, 1941, **73**, 5179.
2. Aydon, M., *J. Chem. Soc.*, 1957, p. 1811.
3. Mino, Kazetman and Rasmussen, *J. Am. Chem. Soc.*, 1953, **81**, 1484.
4. Muhammad, S. S. and Vijayachander Rao, K., *Bull. Chem. Soc. of Japan*, 1963, **36** (8), 943 and 949.
5. Duke, F. R. and Forist, A. A., *J. Am. Chem. Soc.*, 1949, **71**, 2790.
6. Shoner, L., *J. Chem. Soc.*, 1962, p. 1868.
7. Sethuram, B. and Muhammad, S. S., *Adv. Chem. Ser. Hongk.*, 1966, **46** (2), 11b and 125.

A MODIFICATION OF FRIEDEL-CRAFTS REACTION

In connection with a research project, we required a number of aromatic ketones, which could be prepared by the application of the Friedel-Crafts reaction. In the latter reaction we have found that instead of using the required acid chloride or anhydride, the free acid itself could be used in the presence of an excess of anhydrous aluminium chloride, the yields of the ketones obtained by this modification usually ranging from 76 to 90%. The general procedure consists in refluxing a mixture of 1 mol. of the acid, about 3 moles of anhydrous aluminium chloride and an excess of the aromatic component.

The following ketones have been prepared by this method.

TABLE I

No.	Ketones	Yield %	B.P.	M.P. of 2-4 D.N.P.	Nitrogen Analysis	
					Found	Calculated
1	<i>p</i> -Chloro-acetophenone	90	..	..	..	..
2	<i>p</i> -Bromo-acetophenone	83	..	..	..	..
3	Propiophenone	80	..	..	..	..
4	<i>p</i> -Chloro-propiofenone	80	..	..	..	..
5	<i>p</i> -Bromo-propiofenone	79	..	..	..	..
6	<i>p</i> -Ethyl-propiofenone	84	..	..	..	..
7	Butyrophenone	80	..	..	..	..
8	<i>p</i> -Chloro-butyrophenone	81	92°/1 mm.	189-90°*	15.2	15.4
9	<i>p</i> -Bromo-butyrophenone	81.5	98-109°/1.5 mm.	184-85°*	13.9	13.73
10	<i>p</i> -Ethyl-butyrophenone	84	122-25°/1 mm.	173-75°	15.9	15.73
11	* <i>p</i> -Bromo-valerophenone	79	119-127°/0.7 mm.	169-70°	13.42	13.8
12	* <i>p</i> -Bromo-caprophenone	77	78-84°/0.5 mm.	166-68°	12.6	12.87
13	* <i>p</i> -Bromo-caprylophenone	78	142-5°/1.5 mm.	106-08°	12.4	12.11
14	* <i>p</i> -Chlorocaprophenone	79.5	136-140°/1 mm.	165-68°	14.6	14.4
15	* <i>p</i> -Chlorocaprylophenone	76	148-152°/2 mm.	140-42°	13.6	13.4
16	<i>p</i> -Chloro-benzophenone	53	..	..	..	..

* Unknown compounds.

Dept. of Organic Chemistry, A. M. Z. KAZI.
Institute of Science, J. R. MERCHANT.
Mayo Road, Bombay-1,
January 19, 1966.

REVISION OF THE TERM BUNDELKHAND GNEISS (GRANITE) IN RAJASTHAN

F. R. MALLET (unpublished report) instituted the name 'Bundelkhand gneiss' from the state of that name, and it was adopted in the first *Manual of Indian Geology* by Medlicott and Blanford¹ for a gneiss possessing the characters of a coarse pink granite of constant composition and almost free from accessory minerals. Foliation is never well developed.

Oldham² recognised the identity of the granite occurring in the Berach valley, Rajasthan (formerly called Rajputana) with the Bundelkhand gneiss of the type area. This was later confirmed by Heron.³ This unfoliated non-porphyrific granite with no trace of banding, medium and uniform in grain and varying in colour from reddish-pink to pale greenish-yellow, according to the degree of alteration suffered by the feldspars, gradually passes into a grey foliated gneiss. The two varieties have been identified with each other.³

Although the Berach granite and the Bundelkhand granite of the type area are separated from each other by considerable distance (270 miles), yet Heron considered the Rajasthan granite as the equivalent and westward extension of the Bundelkhand granite of the type area. The correlation has been based on homogeneity, invariability, absence (paucity)

of accessory minerals and also the presence of associated quartz veins and basic intrusives which are the characters common to both. Whatever differences existed between them are of no importance according to Heron.

The absolute age determinations carried out on the rocks of the two areas are of significance in this connection.

Coarse biotite from the schist inclusion in granite near Dumra, Chattarpur (Bundelkhand type area) yields A⁴⁰/K⁴⁰ ages 2,500 m.y. and 2,510 m.y., which date the episode of metamorphism and granitisation during the closing stage of the Bundelkhand orogeny.⁴ Argon age determinations of Bundelkhand gneisses of Rajasthan have given value of 1,500 m.y., of the crystalline basement 3,500 m.y. which was eroded during the Aravalli sedimentation, and of the Aravalli schist 1,500 m.y.⁵

Heron thinks that Bundelkhand (Berach) granite of Mewar is pre-Aravalli (pre-Dharwar). Many geologists⁶⁻⁸ think it to be post-Dharwar. Fermor⁹ thinks that it intruded into the Dharwars subsequent to the Dharwarian folding. Krishnan¹⁰ in his table of the 'Rough Correlation of the Peninsular Archæans' puts the Bundelkhand gneiss with younger granites as Closepet granite, Bellary gneiss and Dome gneiss, etc., with a question mark, and with the oldest Archæans also, again with a question mark.

As is evident from the absolute age determinations, the Bundelkhand gneiss of Rajasthan (1,500 m.y.) differs very widely in age from the Bundelkhand gneiss of the type area (2,500-2,510 m.y.). Besides the above, the Bundelkhand gneiss of the type area differs from the Bundelkhand (Berach) granite of Rajasthan in

the following aspects: (1) Neither the rock is homogeneous nor invariable; (2) There is a lot of variation in the gneissic type; (3) There is no dearth (paucity) of accessory minerals; (4) Foliated as well as non-foliated varieties of various shades, textural and mineralogical composition occur. Within the main granitic mass occur the xenoliths of older metasedimentaries, the granitisation of which resulted in the formation of the various types of Bundelkhand gneisses and granites. The older xenolithic rocks occurring in the Hamirpur and Jhansi Districts of Bundelkhand type area have been found to be equivalent of middle Dharwars (a fact also confirmed by absolute age determinations), whereas the migmatites and migmatitic gneisses and granites are considered to be post-Dharwars.^{7,8}

The chemical composition of any two specimens cannot be treated as a safe criterion for the correlation purposes because there are several textural and mineralogical variations in each area. This is also the case in all the world occurrences of granites.

In view of the above differences (absolute age, lithologic, petrographic and petrologic differences) between the rocks of the Bundelkhand type area and the Bundelkhand granites occurring in Rajasthan separated by hundreds of miles, the author proposes that the "regional term 'Bundelkhand gneiss'" should be restricted to the type area and not extended to Rajasthan. However, in Rajasthan, the term may be substituted by its own regional term like 'the Rajasthan granite' or 'Berach' granite.

The author is grateful to Prof. P. R. J. Naidu for very valuable discussions and for going through the manuscript.

Department of Geology,

M. N. SAXENA.

Panjab University,

Chandigarh, December 27, 1965.

1. Medlicott, H. B. and Blanford, W. T., *Manual of Indian Geology*, Calcutta, 1879, p. 10.
2. Oldham, R. D., *Ibid.*, 2nd Ed., 1893
3. Heron, A. M., *Mem. Geol. Surv. Ind.*, 1936, 68 (1), 5.
4. Sarkar, S. N., Polkarov, A. A. and Gerling, E. K., *Sci. and Cult.*, 1964.
5. Avinogradov, Tugarinov, A., *Geochronology of Indian Pre-Cambrians Circulated in I. G. C.*, 1964.
6. Jhingran, A. G., *Proc. 15th Ind. Sci. Congr.*, 1958, 2.
7. Saxena, M. N., "Bundelkhand granites and associated rocks", *Ph.D. Thesis*, Lucknow University, Lucknow, 1957.
8. —, *Research Bull. (N. S.) of the Panjab University*, 1961, 12, (I-II), 85.
9. Fernor, L. L., *Mem. Geol. Surv. Ind.*, 1909, p. 37.
10. Krishnan, M. S., *Geology of India and Burma*, Madras, 1956.

ON THE OCCURRENCE OF A FOSSIL DICOT WOOD FROM DUDUKUR NEAR RAJAHMUNDRY

THE present communication deals with a chertified fossil dicotyledonous wood collected by one of us (J. S. R. K.) during a recent survey of the area between the longitude 81° 33'–81° 40' and latitude 17° 0'–17° 3' at Dudukur near Rajahmundry. The fossil showing only secondary wood is 8 inches long and 5 inches in diam. and has been picked up from the quarry debris by the side of a quarry consisting of intertrappean marls, clays and limestones. The intertrappean bed is overlain by basalt constituting a hillock known locally as Pusalakonda. The authors are not aware of any previously published record of a fossil dicot wood from the Dudukur area.

The preservation is satisfactory only in some parts of the wood. The tissues in general are in a highly contorted condition. Further, the transverse sections show some irregular cavities without contents. It is probable that the wood might have undergone partial decay before fossilization. The following are the xylotomical characters seen in the fossil (Figs. 1–3).

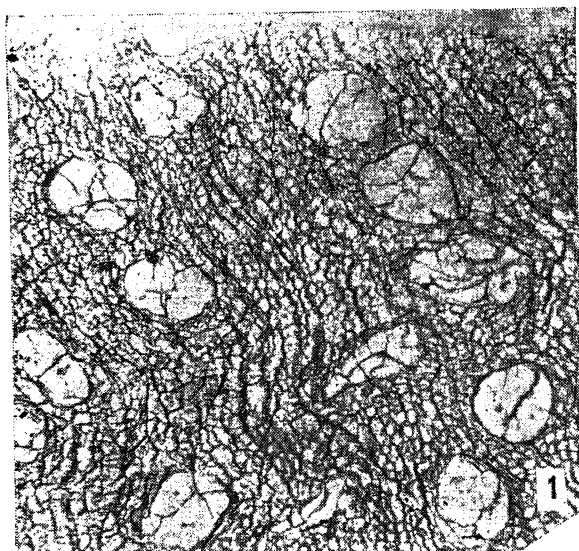
Wood diffuse-porous. Vessels mostly solitary (70%), sometimes in radial groups of 2 or 3; 50–130 μ in tangential diam., the majority being 70–95 μ , 15–20 per sq. mm., contiguous with xylem rays on one or both sides, rounded to oval, often flattened, commonly tylosed. Vessel members 330–700 μ long, perforations simple, oblique. Intervessel pits vestured, alternate, rounded or angular. Xylem parenchyma not seen. Fibres non-libriform, angular, aligned in regular radial rows, 18–25 μ in diam., 750–950 μ long, usually with one or two septa, non-septate ones not uncommon; profusely pitted, pits being in one or two linear rows, rounded, narrowly bordered. Xylem rays 12–18 per mm., one or two seriate, mostly uniseriate, 2–15 cells high, homogeneous consisting entirely of procumbent cells.

A comparison of the fossil with the woods of recent families of angiosperms indicates its strong affinities with Sonneratiaceae.^{1,2} In the present-day Sonneratiaceae the species of *Duabanga* generally show the presence of xylem parenchyma although limited, in the form of thin vasicentric sheaths and the rays are predominantly heterogeneous and occasionally upto 3 cells thick. Woods of *Sonneratia*, on the other hand, lack xylem parenchyma and possess mostly uniseriate, short, homogeneous rays and fibres with numerous small narrowly bordered

pits. The Dudukur fossil resembles more the woods of *Sonneratia* rather than *Duabanga*. It has been placed in the genus *Sonneratioxylon* Hofman.³

*Sonneratioxylon dakshinense*⁴ from the

on comparison with the Indian and foreign species of this genus has been found to possess a distinct combination of characters and hence placed in a new species, *Sonneratioxylon dudukurens* sp. nov.



FIGS. 1-3. Fig. 1, $\times 120$; Fig. 2, $\times 120$; Fig. 3, $\times 120$.

Cuddalore sandstones near Pondicherry represents the only previously known species of this genus from India. The Dudukur fossil

The type specimen bearing the number D 100 is in the Department of Geology, Andhra University, Waltair,

Geology Department J. S. R. KURUPA RAO
Andhra University
Walapudi

and
Botany Department C. G. K. RAMANUJAM
Osmania University,
Hyderabad.

November 30, 1965

1. Pearson, P. and Brown, H. *Chemical Analysis*, 1952, 2.
2. Venkateswarlu, L. and Prasad, K. *Chemical Abstracts*, 1964, 59, 6.
3. Horner, L. *Zeitschrift für Chemie*, 1962, 92 B, 173.
4. Ramakrishna, C. S. K. *Indian Journal of Chemistry*, 1964, 5, 78.

SEQUESTERING OF IRON AND ALUMINUM BY SOIL POLYSACCHARIDES*

MANY investigators have suggested that soil organic matter is capable of complexing or chelating metals and that such complexes are important in soil formation, plant nutrition and structure formation. The complex formation, therefore, attracts a growing interest and some reviews on the subject have appeared in recent years^{1,2}. These reviews and subsequent studies^{3,4,5} indicate that except Mortensen⁶ all other investigators confined their work to humic acids and fulvic acids. Mortensen's⁶ work showed that soil polysaccharides are capable of forming water-soluble complexes with copper.

Soil polysaccharides, iron and aluminum are reported to be important in aggregate formation⁷ but Mehta *et al.*⁸ have shown that polysaccharides alone were not responsible for aggregate formation. It is likely, therefore, that stability of structure may be a function of the metallo-polysaccharide complexes.⁹ Hence this preliminary study was undertaken to investigate if iron and aluminum are sequestered¹⁰ by soil polysaccharide so that it might give a better understanding of the mechanisms of aggregate formation.

Polysaccharide for the study was extracted from Wadburn clay loam with hot water according to Mortensen.⁶ Chromatographic analysis of the hydrolyzate showed that the polysaccharide was composed of rhamnose, fucose, xylose, arabinose, mannose, glucose, galactose and small quantities of uronic acid groups. A spectrochemical¹¹ analysis of the purified sample showed Si, P, Mn, Cu, Al, Fe, Na and possibly Mg as impurities.

Charberek and Martell¹² list the following items for confirmation of complex formation:

(i) pH effect, (ii) adsorption spectra, (iii) oxidation potential, (iv) polarographic measurements, (v) conductance, etc. The first two, namely, pH effect and ultraviolet adsorption spectra, were employed as criteria for complex formation. pH was measured by a Beckman Zeromatic II pH meter and the absorption spectra of the same solutions were taken by a Beckman Spectrophotometer model DU with an automatic recorder.

All metallo-organic complexes may be considered to be formed by the displacement of one or more usually weak acidic protons of the complex forming agent by a metal ion, and, therefore, complex formation is accompanied with pH decrease (Table I). This decrease in pH was more pronounced in the Fe polysaccharide complex and less in Al polysaccharide complex. The pH of FeCl₃ alone was 5.3 (solution b) and the pH of polysaccharide solution containing 200 µg/ml polysaccharide was 5.4 (solution c). When both constituents were present together in a solution, the pH was 4.8 (solution e). The pH of AlCl₃ solution was 5.0 (solution a) and the pH of the Al complex remained 5.0 (solution d) although the pH of the polysaccharide solution was 5.4 (solution c). The decrease in pH was still more pronounced when a polysaccharide solution containing 100 µg/ml was used. The pH of the solution containing 100 µg/ml polysaccharide was 5.6 but the pH of the Fe and Al complexes was 4.8 and 5.2 respectively.

TABLE I

Effect of iron and aluminum ions on the pH of polysaccharide solution

	pH
(a) 20 ml H ₂ O + 1 ml (0.001 M) AlCl ₃	5.0
(b) 20 ml H ₂ O + 1 ml (0.001 M) FeCl ₃	5.3
(c) 20 ml polysaccharide solution (200 µg/ml) + 1 ml H ₂ O	5.4
(d) 20 ml polysaccharide solution (200 µg/ml) + 1 ml (0.001 M) AlCl ₃	5.0
(e) 20 ml polysaccharide solution (200 µg/ml) + 1 ml (0.001 M) FeCl ₃	4.8
(f) 20 ml polysaccharide solution (100 µg/ml) + 1 ml H ₂ O	5.6
(g) 20 ml polysaccharide solution (100 µg/ml) + 1 ml (0.001 M) AlCl ₃	5.2
(h) 20 ml polysaccharide solution (100 µg/ml) + 1 ml (0.001 M) FeCl ₃	4.8

The degree of pH decrease generally corresponds to the stability of complex formed and thus may be taken as a qualitative index of stability constants. It indicates, therefore, that the stability constant of Fe polysaccharide complex is higher than the Al-polysaccharide

complex. It is difficult to compare these results with any others because no one yet has reported on the complex formation between soil polysaccharide and iron and aluminum. However, the results of Kawaguchi and Kyuma,⁴ who

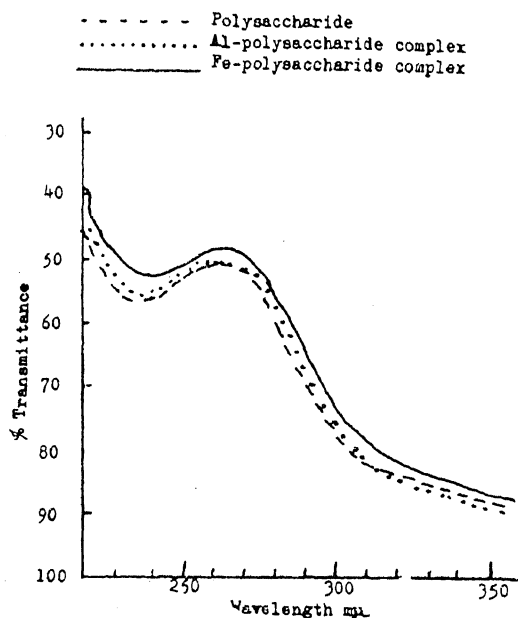


FIG. 1. Ultra-violet absorption spectra of soil polysaccharide and its metal complexes (Polysaccharide concentration 100 $\mu\text{g./ml.}$).

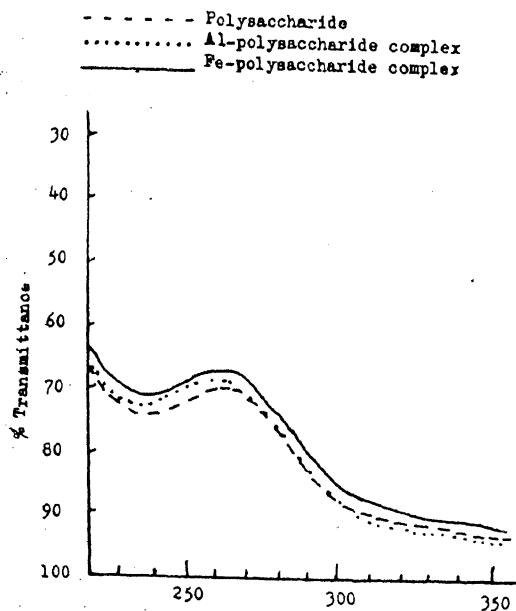


FIG. 2. Ultra-violet absorption spectra of soil polysaccharide and its metal complexes (Polysaccharide concentration 100 $\mu\text{g./ml.}$).

reported on the water-soluble complexes of iron and aluminum with fulvic acid in Japanese soils, are similar where the authors using potentiometric titrations found that Fe-fulvic acid complex has a higher stability constant than Al-fulvic acid complex.

The results obtained by pH measurements were further substantiated by the ultra-violet absorption spectra of the polysaccharide and its complexes with iron and aluminum (Figs. 1 and 2).

No shift in the frequency of the absorption band was observed but there was a slight increase in intensity of the band which suggests that some portions of the electrolyte and polysaccharide have been used up in the formation of a complex; Fe-complex showing more absorption than the Al-complex. Relative shifts in frequency and intensity of the absorption bands of a ligand resulting from complex formation have been used for formation constant calculations.² This again qualitatively shows that Fe-polysaccharide complex has a higher stability constant than the Al-polysaccharide complex.

Research Station,
Canada Dept. of Agriculture,
P.O. Box 280, Fredericton,
New Brunswick, December 15, 1965.

G. R. SAINI.

*Contribution No. 210, Research Station, Canada Department of Agriculture, Fredericton, New Brunswick.

**Charberek and Martell (2) state that when a ligand forms a stable, water-soluble metal chelate, the ligand is said to be a sequestering agent and the metal is said to be sequestered.

†Thanks are due to Prof. R. D. Verma, Physics Department, University of New Brunswick, for the spectrochemical analysis.

1. Adachi, Michiko, "On the eluviation and accumulation of sesquioxides by fulvic acid," *Soil Sci. and Plant Nutrition*, 1965, **11** (2), 49.
2. Charberek, S. and Martell, A. E., *Organic Sequestering Agents*, John Wiley & Sons, Inc., 1959.
3. Chesters, G., Attoe, O. J. and Allen, Q. N., "Soil aggregation in relation to various soil constituents," *Soil Sci. Soc. Am. Proc.*, 1957, **21**, 272.
4. Kawaguchi, K. and Kyuma, K., "On the complex formation between soil humus and polyvalent cations," *Soil and Plant Food*, 1959, **5**, 54.
5. Martin, J. P., Martin, W. P., Page, J. B., Raney, W. A. and DeMent, J. D., *Soil Aggregation: Advances in Agronomy*, 1955, **7**, 1.
6. Mehta, N. C., Streuli, H., Muller, M. and Deuel, H., "Role of polysaccharides in soil aggregation," *J. Sci. Food and Agr.*, 1960, **11**, 40.
7. Mortensen, J. L., "Physico-chemical properties of a soil polysaccharide," *Trans. Intern. Congr. Soil Sci. 7th Congress, Madison*, 1960, **2**, 98.
8. —, "Complexing of metals by soil organic matter," *Soil Sci. Soc. Am. Proc.*, 1963, **27**, 179.
9. Randhawa, N. S. and Broadbent, F. E., "Soil organic matter complexes," *Soil Sci.*, 1965, **99**, 295 and 362.

10. Saini, G. R. and MacLean, A. A., "The influence of some physical and chemical properties on soil aggregation (Unpublished).
11. Schnitzer, M. and Skinner, S. I. M., "Organo-metallic interactions in soils," *Soil Sci.*, 1965, **59**, 278; 1963 **96**, 86 and 181.
12. Stewart, Ivan, "Chelation in the absorption and translocation of mineral elements," *Ann. Rev. Plant Phys.*, 1963, **14**, 295.
13. Wright, J. R. and Schnitzer, M., "Metallo-organic interactions associated with podzolization," *Soil. Sci. Soc. Am. Proc.*, 1963, **27**, 171.

OCCURRENCE OF A NEW LEAF WEEVIL PEST (*CRYTOZEMIA DISPAR*, PASC) ON COTTON CROP IN GUJARAT STATE

A NEW leaf weevil pest (*Crytozemia dispar*, Pasc) is found on cotton crop in Junagadh District of Gujarat State since the year 1964. It damages leaves of cotton plants by feeding on them. Since the pest appeared on cotton crop during 1965 also and in a wider area, it is feared that it will get established in Junagadh area and may spread to other parts of the State also. There is no literature available on this insect as a pest.

The pest was noticed for the first time in a cotton field of Joshipura village near Junagadh. A number of adults were noticed on cotton leaves which were found considerably damaged. The adults start feeding on leaves firstly from the leaf margins and then cut irregular holes in the leaves. In the case of severe attack leaves were damaged so much that the affected plants looked almost skeletonised.

The adult weevil, brown or dark brown in colour, measured about 3 to 4 mm. long and 2 mm. broad and had geniculate antennæ. They appeared in large numbers in a sporadic way at the time of active vegetative growth of the crop and disappeared after the preflowering stage was over. It was observed that the rainy atmosphere was more favourable for the multiplication of this pest. Some preliminary observations were made on the various stages of the pest. Eggs were laid singly from 15 to 30 in number arranged in circle. They were black in colour and wart-like in shape. At the end of the monsoon the larvæ that hatched from eggs could not be reared further as they died. The larvæ were apodous.

During the year 1965-66, a survey was carried out on the distribution of the pest on the varieties of cotton commonly cultivated in Gujarat State, and also on some promising strains of Indo-American cotton in the Cotton

Breeder's plot at Sagdividi Farm, Junagadh. Observations were recorded on three stages of plant growth, namely, active vegetative growth, preflowering and prebolling stage. As there was only one row under each strain all the plants were observed for the presence of the weevil pest in the case of each strain. In the case of varieties which were grown in plots, 100 plants were selected at random and examined for the same.

For the control of the pest, insecticidal experiments on 170-Co2 cotton with some recent insecticides were carried out, with four replications of the treatments, at Sagdividi Farm. The plot size was 15' × 36'. The interval between two dustings or sprayings was 21 days. Only two dustings or sprayings were given. Observations were taken 24 hours before and 48 hours after each spraying or dusting on 5 plants selected at random in each treatment, for the number of leaves damaged by the pest on each plant and also for presence of the number of weevils on each plant.

The results of the survey work for the distribution of the pest are given in Table I.

TABLE I
Showing distribution of cotton leaf weevil on
various varieties and strains

Sl. No.	Name of the variety or strain on which the attack on weevils was noticed	Average number of weevils per plant at			
		Active vegetative growth	Preflowering stage	Prebolling stage	
Indo-American cotton					
1	I.S. C-67 (Gujarat)	..	1.15	0.12	0.00
2	Co2-170 (Deviraj)	..	1.24	0.17	0.00
3	Co2-134 M (Devitej)	..	1.90	0.14	0.00
4	I.S.C-35	..	1.00	0.00	0.00
5	170-Co2-2-3	..	1.00	0.30	0.00
6	134-Co2, M-21-4	..	1.20	0.20	0.00
American cotton					
1	320 F	..	1.20	0.33	0.00
Deshi cotton					
1	Kalyan	..	0.00	0.00	0.00
Barbadensa type					
1	Andrew	..	1.15	0.28	0.00
2	Pima	..	1.18	0.20	0.00

The data of Table I reveal that the pest was confined to Indo-American, American and also Barbadensa types of cotton, while the *Deshi* cotton Kalyan was free from its presence and damage. It can also be seen that the population of the pest was more at the time of the active vegetative growth of the crop.

The results of the insecticidal control experiments carried out at Sagdividi Farm are given in Table 2.

TABLE II

Showing increased percentage of damage and reduction in the population of the pest after angular transformation

Treatments	Mean increase in per cent. damage to leaves	Mean percentage reduction in population
Thiodan 4% dust at 20 lb./acre	29.17	53.64
Carbaryl 10% dust at 20 lb./acre	14.98	81.18
Carbaryl 0.15% at 60 gals. of spraying per acre	27.19	62.91
DDT 5% dust at 20 lb./acre	21.89	64.49
Control	37.69	49.78
S.E. : 3.54 } Per S.E. : 7.47 } Per C.D. : 7.71 } plot C.D. : 16.28 } plot		

The results of Table II are statistically significant for both reduction in population of the pest and less increase in damage on leaves. Carbaryl 10% dust with 2 dustings with the first dusting started from the time of the appearance of insects, i.e., 1st October and repeating the dusting after 21 days gave the best results in respect of both reduction in population of the pest and less increase in the damage.

The authors are thankful to Dr. G. A. Patel, Director of Agriculture, Gujarat State, for his keen interest in the present work and to the Director, Commonwealth Institute of Entomology, London, for identification of the species.

Entomology Section, R. M. PATEL
College of Agriculture, G. SAHAY.
Junagadh, December, 21 1965.

SPOROGENESIS AND THE DEVELOPMENT OF GAMETOPHYTES IN *ERIOCAULON QUINQUANGULARE* LINN.

THE family Eriocaulaceæ mostly consists of marshy herbs with highly condensed stems and rosettes of radical leaves. The inflorescence is a globose head with unisexual flowers. The genus *Eriocaulon* is the most extensive genus among the six genera¹ in the family and is represented by about 27 species² in South India. The only previous literature available on the embryology of *Eriocaulon* is by Smith⁴ (1910) and Patel³ (1964).

The present work deals with the sporogenesis and the development of the male and the female gametophytes in *Eriocaulon quinquangulare* Linn.

The anther primordium consists of a homogeneous mass of cells. The hypodermal archesporial initials appear in a single row and are differentiated even before the anther lobes become recognisable (Fig. 1). Periclinal division of the archesporium results in the outer primary parietal layer and an inner primary sporogenous layer. The primary parietal layer forms a three-layered anther wall after further divisions. The innermost layer of the anther wall functions as tapetum and the outermost becomes the endothecium and develops conspicuous fibrillar thickenings at later stages except at the region of dehiscence (Figs. 2, 3, 6).

In a longitudinal section the microsporocytes appear in a single row surrounded by the tapetum all round (Fig. 3). The tapetal cells are uninucleate to start with but become binucleate at about the time when the sporocytes are ready to divide. By successive meiotic divisions isobilateral and decussate microspore tetrads are formed (Fig. 4).

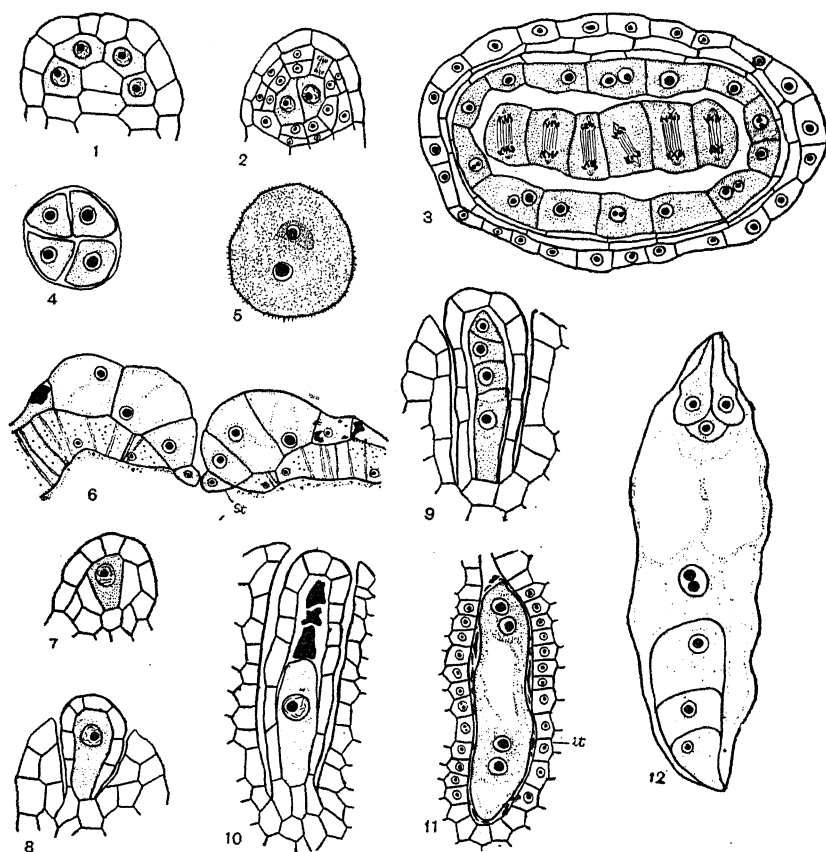
A mature anther is four-lobed. The tapetum and the middle layers disorganise completely and only the epidermis and the fibrillar endothecium persist. A regular stomium is developed. The epidermal cells show dark contents (Fig. 6). The pollen grains possess a thick exine with very small spinescent projections and are shed at two-celled stage (Fig. 5).

The ovary is superior, tricarpeal, trilobular and syncarpous with a solitary, pendulous, bitegmic and tenuinucellate ovule in each locule.

The ovules arise as small protuberances from the axile placenta. At first they are directed towards the carpel but with further growth assume a bent position with the micropyle directed towards the base of the flower.

The primary hypodermal archesporium is usually single-celled and is distinguishable before the integumentary primordia appear (Fig. 7). The archesporial initial directly functions as the megasporocyte (Fig. 8). Meiotic divisions result in linear, obliquely linear and T-shaped tetrads of megaspores, of which the linear type is most common (Fig. 9). The chalazal megaspore develops further and gives rise to an eight-nucleate embryo sac of Polygonum Type (Figs. 10, 11, 12).

An integumentary tapetum is organised when the embryo sac is four-nucleate (Fig. 11). In a mature embryo sac the egg apparatus consists of a pair of hooked synergids and a rounded egg. The antipodals are very conspicuous and show a linear arrangement. The two polar nuclei fuse before fertilization (Fig. 12).



FIGS. 1-12. Figs. 1-6. *Microsporogenesis and male gametophyte*. Fig. 1. Archesporium, $\times 1,455$. Fig. 2. Part of anther showing anther wall and sporogenous cells, $\times 1,455$. Fig. 3. Binucleate tapetal cells and microsporocytes under meiosis I, $\times 1,455$. Fig. 4. Isobilateral microspore tetrad, $\times 1,455$. Fig. 5. Two-celled pollen grain, $\times 1,455$. Fig. 6. Fibrillar endothecium and stium, $\times 1,164$. Figs. 7-12. *Megasporogenesis and female gametophyte*. Fig. 7. Archesporium $\times 1,455$. Fig. 8. Megasporocyte, $\times 1,455$. Fig. 9. Linear tetrad, $\times 1,455$. Fig. 10. Functional megaspore, $\times 1,455$. Fig. 11. Four-nucleate embryo sac, $\times 1,455$. Fig. 12. Eight-nucleate embryo sac, $\times 1,164$.

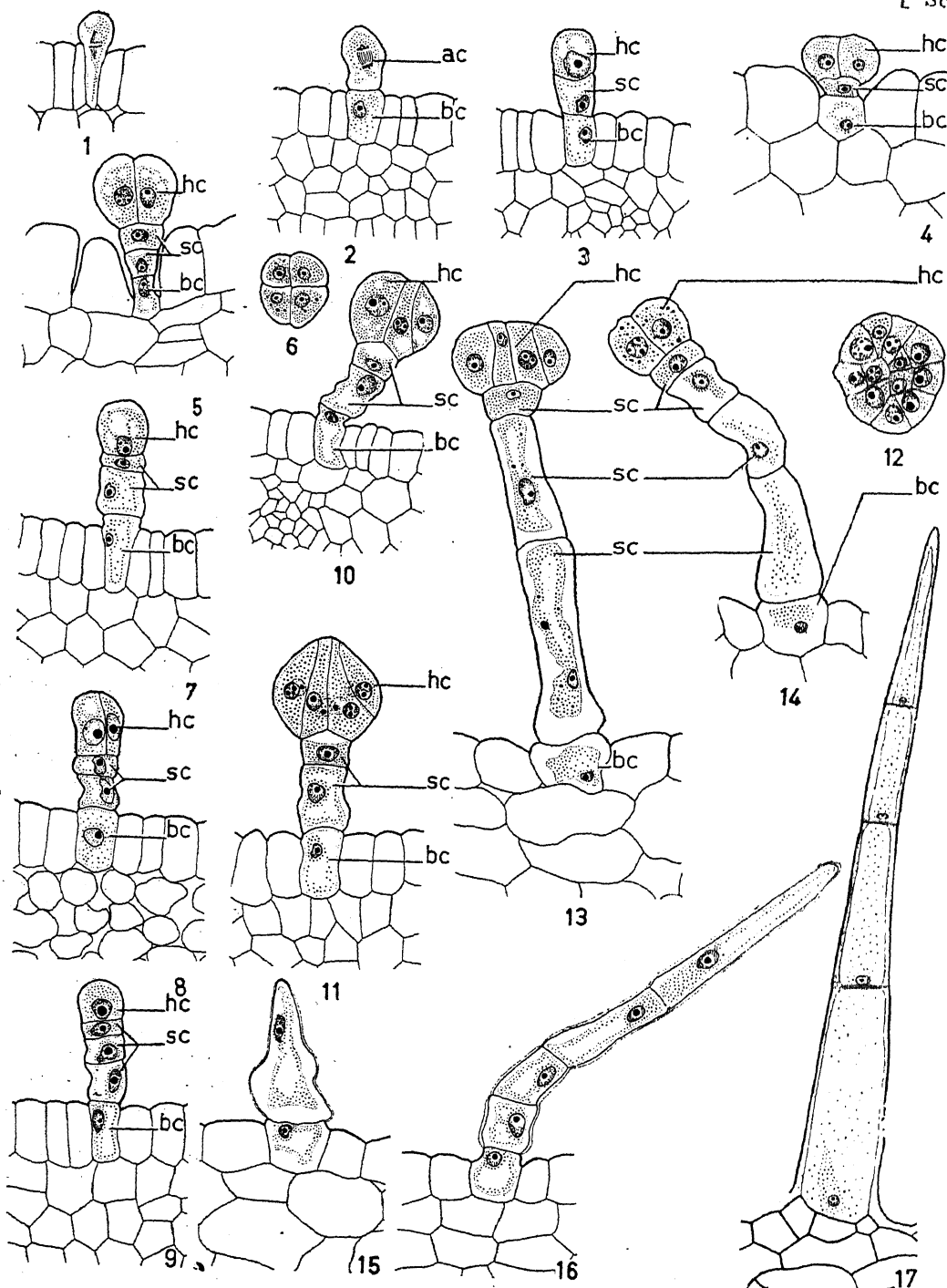
My sincere gratitude to Dr. M. Nagaraj for his guidance. Thanks are also due to Sri. T. Thathachar for his kind suggestions and encouragement.

Department of Botany, MAQBOOL BEGUM.
Maharani's College,
Bangalore, December 22, 1965.

A STUDY OF TRICHOMES IN TWO SPECIES OF ACANTHACEAE

It is well known that trichomes in Acanthaceae have some taxonomic value. For instance, Nitolitzky³ recognized, on the basis of epidermal ornamentation, four major types of acanthaceous seeds and Bremekemp¹ distinguished three Surinam species of *Mendoncia* by the shape of leaf hairs. Metcalfe and Chalk² described two types of hairs in the family (1) glandular and (2) non-glandular. The species *Asystasia gangetica* and *Justicia simplex*, studied here, show both these types. The simple, multicellular, uniseriate hairs are found on the stem, leaf and floral parts of both *Asystasia* and *Justicia*, excepting the ovary of the latter. They are cutinized and pointed at the

1. Engler and Prantl, *Die Pflanzen Familien*, II Teil (IV-VI), 1897.
2. Gamble, J. S., *Flora of Presidency of Madras*, 1956, 3, 1119.
3. Patel, C. M. and Patel, D. S., 'The morphological and Embryological studies in *E. cinereum* R. Br.', *Journal of Gujarat Univ.*, 1964, 7 (1), 58.
4. Smith, R. W., "The floral development and embryogeny of *E. septangulare*," *Bot. Gaz.*, 191, 49, 281, Taf. 19-20.



FIGS. 1-17. Development of hairs in *Arystasia gangetica* and *Justicia simplex*. Figs. 1-4. *Arystasia gangetica*. Fig. 1. Papillate hair initial, $\times 535$. Figs. 2, 3. Two- and 3-celled stages of glandular hair, $\times 377$. Fig. 4. Glandular hair with 4-celled head, $\times 377$. Fig. 5. *Justicia simplex*. Glandular hair with 4-celled head and 2-celled stalk, $\times 535$. Fig. 6. *Arystasia gangetica*. T.s. through 4-celled head of glandular hair; the head cell has divided vertically in Fig. 8, $\times 377$. Figs. 7-9. Four and 5-celled stages of glandular hair, $\times 377$. Figs. 11; 13. Hairs with 2- and 3-celled stalk and multicellular head, $\times 377$. Fig. 12. T.s. through multicellular head of the glandular hair, $\times 377$. Fig. 14. Glandular hair with 4-celled stalk, $\times 535$. Figs. 15; 16. *Arystasia gangetica*. Development of simple, uniseriate, multicellular hairs, $\times 377$. Fig. 17. *Justicia simplex*. 4-celled uniseriate, multicellular hair, $\times 377$.

apex. The glandular hairs may be further distinguished into two categories on the basis of the size and position of the stalk: (A) with 1- or 2-celled deeply sunk stalk and 4-celled head, found on the leaves and sepals of *Asystasia* and on the bracts, sepals and petals of *Justicia* and (B) with 2- to 4-celled elongated stalk and multicelled head on the leaves, sepals, petals and stamens of *Asystasia* and the bracts, sepals and petals of *Justicia*. However, in *Asystasia* these hairs are much more abundant than in *Justicia*.

The course of development of the glandular hairs in *Asystasia* and *Justicia* differ mainly in the number of cell divisions. Every hair originates from a single epidermal cell which becomes more conspicuous on account of its dense cytoplasm, and prominent nucleus. This hair initial becomes papillate and divides transversely (Fig. 1) into a basal cell (bc) and an apical cell (ac; Fig. 2). The former generally remains a single cell and forms the foot while the latter has dense cytoplasm, a comparatively large nucleus and undergoes successive transverse divisions forming 1- to 4-celled stalk and a head cell (Figs. 3, 7, 9). In the type with deeply sunk stalk (type A) the head cell (hc) undergoes two divisions at right angles to each other to give rise to a 4-celled head (Figs. 4-6). At maturity the foot recedes into the hypodermis (Figs. 4, 5).

In the case of hairs having elongated stalk (type B) the head cell undergoes vertical and oblique divisions (Figs. 8, 10, 11, 13, 14) to form 4- to 8-celled head in *Justicia* and 12- to 16-celled in *Asystasia* (Fig. 12). In a few cases head consisting of as many as 20 cells was also observed in *Asystasia*. Rarely the foot cell may also divide vertically to produce 2-celled foot. In the glandular hairs the head cells are densely cytoplasmic and are the secretory part of the hair.

In the simple, uniseriate, multicellular hairs soon after the 2-celled stage, the apical cell elongates and assumes a tapering appearance (Fig. 15). Successive transverse divisions result in the formation of a uniseriate 4- to 6-celled simple hair (Figs. 16, 17). The basal cell may also sometimes become 2-celled.

I take this opportunity to express my deep gratitude to Prof. P. Maheshwari, Prof. V. Puri, Dr. R. N. Kapil and Dr. Y. S. Murty for their guidance, invaluable help and encouragement.

School of Plant

SNEH LATA MATHUR.

Morphology,*

Meerut College, Meerut, January 13, 1966.

* The work was carried out at the Department of Botany, University of Delhi, Delhi-7.

1. Breckemeyer, C. E. B., *Rec. Trav. Bot. néerl.*, 1938, **35**, 130.
2. Metcalfe, C. R. and Chalk, L., *Anatomy of Dicotyledons*, Clarendon Press, Oxford, 1950. 2.
3. Nitolitzky, F., *Anatomie der Angiospermen-Samen*, in Linsbauer, K., ed., *Handbuch der Pflanzen-anatomie*, Berlin, 1926.

DIPLOID AND TETRAPLOID SPERMATOGONIA IN *BOMBYX MORI* L.

SEVERAL types of parthenogenesis have been reported in silkworms.¹ Some have been shown to give rise to homozygous males or females while the apomictic type has been used to maintain hybrid females as clones for several generations.² While a study of parthenogenesis is interesting in itself, there is also the probability of its utility in producing or maintaining without change improved strains.

The serious limitation in such a study is the lack of availability of a reliable technique to study the chromosomes. This feature is highlighted by Roginskaya³ who investigated the spermatogenesis in the tetraploid males produced by thermal shocks. The conclusions presented are only from sections.

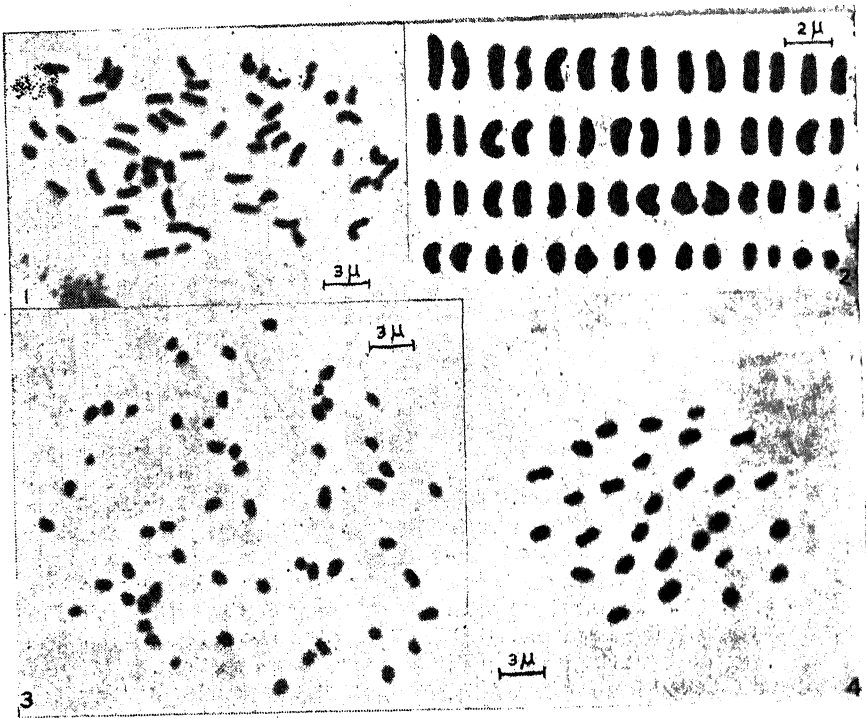
Kawaguchi⁴ explored the utility of acetocarmine squashes to elucidate the chromosome behaviour in polyploid silkworms. He has commented on the difficulty in scattering the chromosomes in the diploid spermatogonia and reported failure to obtain a satisfactory scattering in the tetraploid. The illustrations of chromosomes presented by Tazima in his monograph¹ are only of meiotic I metaphases. The utility of the hæmatoxylin squash technique^{5,6} to study the chromosomes of silkworms was, therefore, explored.

The testes of H.S 6 strain of *Bombyx mori* L. were dissected out on the first and second days of the III instar, pretreated with 0.9% sodium citrate solution for 30 minutes,⁷ fixed in acetic alcohol (1:3) for 2 hours and stored in 70% alcohol for varying periods of time. The material was then hydrolysed in N HCl at 60° C. for 8 minutes, mordanted in a 4% solution of ferric ammonium sulphate for 2 hours and stained with a 0.5% solution of hæmatoxylin for 2-3 hours. The testes were then squashed in a drop of 45% acetic acid. The preparations were made permanent later.

The well-scattered chromosomes could be counted in the spermatogonial pro-metaphase (Figs. 1 and 2) and metaphase (Fig. 3). Tazima¹ comments that the spherical shape of

the chromosomes at metaphase render identification of individual chromosomes difficult. The karyotype (Fig. 2) based on the spermatogonial

gonia were observed in the testes. A scattering of the chromosomes even in tetraploid gonial metaphases appears possible (Fig. 5).



FIGS. 1-4

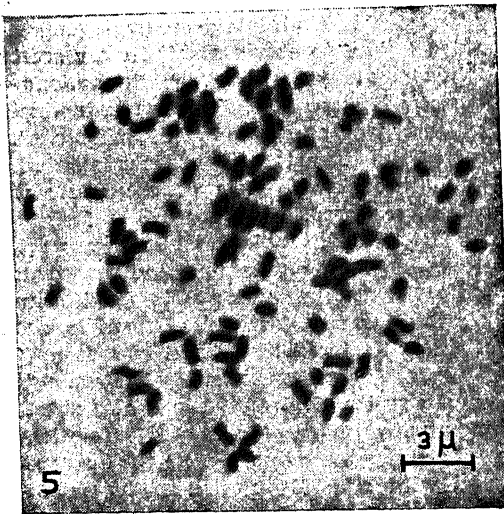


FIG. 5

pro-metaphase reveals size differences among the chromosomes. The 28 bivalents at metaphase I are illustrated in Fig. 4. Rare tetraploid

We are thankful to the Indian Institute of Science, Bangalore, and the Council of Scientific and Industrial Research for their encouragement; to Prof. J. V. Bhat and Dr. M. B. Shyamala of our Institute for their generous donation of silkworm larvae and to Dr. H. Chikushi of the Kyushu University, Fukuoka, Japan, for the gift of microfilm copies of some papers.

Cytogenetics Laboratory, N. B. ELAYIDOM.
Dept. of Biochemistry, SARASWATHI ROYAN-
Indian Institute of SUBRAMANIAM.
Science, Bangalore-12, M. K. SUBRAMANIAM.
March 16, 1966.

1. Tazima, Y., *The Genetics of the Silkworm*, Academic Press, 1964.
2. Astaurov, B. L., *Proc. Zool. Soc. Calcutta, Moskerie Memor.*, 1957, p. 29.
3. Roginskaya, I. S., *Tsitologia*, 1964, 6 (3), 258.
4. Kawaguchi, T., *Cytologia*, 1938, 9, 38.
5. Marimuthu, K. M. and Subramaniam, M. K., *Curr. Sci.*, 1960, 29, 482.
6. Elayidom, N. B., Royan Subramaniam, S. and Subramaniam, M. K., *Ibid.*, 1963, 32, 274.
7. Hsu, T. C., *J. Heredity*, 1952, 43, 167.

REVIEWS AND NOTICES OF BOOKS

Theory of Categories (Vol. 17 of *Pure and Applied Mathematics*). Edited by Smith and Eilenberg. Author: Barry Mitchell. (Academic Press, New York and London), 1965. Pp. xi + 273. Price \$13.75.

This volume covers the main ideas and methods that have been developed through the study of categories since the advent of the subject in 1942. The author begins by laying a unified groundwork for the theory of categories, and then proceeds to treat matters of more specific interest.

In the course of the work it is shown how a large part of the theory developed in Cartan and Eilenberg's *Homological Algebra* need not rely on projectives and injectives. The Yoneda-Baer theory of the Ext function is treated in detail, and a chapter on global dimension indicates that quite a number of the older results on global dimension of rings can be generalized to abelian categories. Freyd's proof of the group valued imbedding theorem and the author's full imbedding theorem are included. There is also a chapter devoted to the theory of sheaves with values in a category. Adjoint functors play a fundamental role throughout the book.

Some familiarity with the elementary theory of groups and modules is the only prerequisite to this volume.

C. V. R.

A Theory of Sets (Volume 18 of *Pure and Applied Mathematics—A Series of Monographs and Text-Books*). Edited by P. A. Smith and S. Eilenberg). Author: Anthony P. Morse. (Academic Press, New York and London), 1965. Pp. xxxi + 130. Price \$7.95.

This book provides graduate students and professional mathematicians with a formal unified treatment of logic and set theory.

Beginning with a formalization that can be used without change to build just about any mathematical structure, the author proceeds with an elegant account of the elements of set theory, presenting several original approaches along the way. Among the novelties are the indication that set theory can be used to explore logic, and the presentation of a strong and useful theorem of classification, a very general induction theorem, a powerful maximal principle, and a rather natural but far-reaching direct extension theorem.

This work will serve as a suitable text-book for a substantial one-semester course in set theory.

C. V. R.

Plasma Turbulence. By Dr. B. B. Kadomtsev. (Academic Press, New York and London), 1965. Pp. vii + 149. Price 40 sh.

This book presents in a concise form the essence of the large body of papers and publications on this difficult yet important subject to which the author himself has contributed many of the original papers.

Various experiments aimed at confining hot plasmas by magnetic fields, which it is hoped will lead ultimately to thermonuclear reactors, have revealed a wide variety of largely unexpected phenomena to do with plasma oscillations.

As the more violent forms of instability of hot plasmas confined by magnetic fields are understood and eliminated from the experiments, one expects finally to be left with a more or less turbulent plasma. If this final obstacle to a stable thermonuclear plasma is overcome it will only be as a result of understanding the nature of the plasma state of matter itself, and *Plasma Turbulence* makes considerable contribution to that understanding.

C. V. R.

Handbook of Microwave Ferrite Materials. Edited by W. H. von Aulock. (Academic Press, New York and London), 1965. Pp. xxiv + 518. Price \$12.00.

In recent years, new insights into the physics of magnetism as well as important applications to microwave devices have given prominence to the study of ferrimagnetic materials.

This reference work for physicists, engineers, and students, who are working with ferrite materials and devices, covers the work on ferrimagnetic material for microwave applications from 1950 through 1963. Garnets, spinels, and hexagonal ferrites are given complete coverage. A systematic annotated review of published data on these three crystallographic classes of ferrites that have figured prominently in microwave applications is presented and tabulated in hundreds of graphs and tables. Two of the tables included will help the reader select suitable ferrites for particular purposes and determine their critical parameters. One of these presents a summary of the properties

After a short introductory chapter on the method, the second chapter discusses in detail with the Kjeldahl digestion. The discussion includes acid requirements, salt addition, oxidizing and reducing agents, catalysis, etc. The third chapter is on digestion procedure firstly for natural products like leather, cereals, foods and proteins, fuels and petroleum; and secondly for organic materials like amino nitrogen, nitro compounds, pyridine and derivatives, heterocyclic nitrogen, etc. The last chapter is on distillation and determination of nitrogen. The classified bibliography of about 60 pages contains nearly 800 references to original papers.

A. S. G.

Concise Notes in Inorganic Chemistry. By R. S. Lowrie. (Pergamon Press, Ltd., Headington Hill Hall, Oxford), Pp. 150. Price 12 sh. 6d.

This book, prepared on the basis of new syllabuses in chemistry for the A and S level examinations in Britain, will be found highly useful as revision notes for pre-university and junior under-graduate classes in India. The book presents in a coherent manner, under 22 chapters, the general principles underlying inorganic chemistry. The treatment is on modern lines against the background of atomic structure and valency theories. As a guide to teachers, and as a handy book for revision, this little publication will find ready welcome. An unfortunate error has crept into the very first page where atomic volume is written as atomic weight \times density.

A. S. G.

Advances in Atomic and Molecular Physics (Vol. 1). Edited by D. R. Bates and I. Estermann. (Academic Press, New York and London), 1965. Pp. 408. Price \$ 13.50.

As the Editors point out this serial publication is intended to occupy an intermediate position between a scientific journal and a monograph. The publication will provide survey articles in fields such as atomic and molecular structure and spectra, masers and optical pumping, mass spectroscopy, physical and chemical interactions with surfaces, etc. The first volume contains the following articles: Molecular orbital theory of the spin properties of conjugated molecules by G. G. Hall and A. T. Amos; Electron affinities of atoms and molecules by B. L. Moiseilish; Atomic rearrangement collisions by B. H. Bransden; The pro-

duction of rotational and vibrational transitions in encounters between molecules by K. Takayangi; The study of intermolecular potentials with molecular beams at thermal energies by H. Pauly and J. P. Toennies; High intensity and high energy molecular beams by J. B. Anderson, R. P. Andres, and J. B. Fenn.

A. S. G.

Advances in Theoretical Physics (Vol. 1). Edited by Keith A. Brueckner. (Academic Press, New York and London), 1965. Pp. 325. Price \$ 12.00.

In recent years work on theoretical physics has become highly specialised and each worker generally keeps close contact with his special field of interest only. This new serial publication is intended to present an overall picture of the progress that is being made in different areas of research in theoretical physics and thus to act as an interdisciplinary medium for the benefit of theoretical physicists working in narrow fields of interest. The first volume of the series contains the following articles: The theory and application of Padé approximate method by G. A. Baker; Theory of the giant dipole resonance by W. Brenig; The optical model by A. L. Fetter and K. M. Watson; Hydromagnetic equilibrium and stability by J. M. Greene and J. L. Johnson; The heavy ion transfer reaction by K. R. Greider; Elastic scattering of electrons by atoms by M. H. Mittleman.

A. S. G.

Books Received

Chemical Aspects of the Automatic Nervous System. By D. J. Triggle. (Academic Press, New York), 1965. Pp. ix + 329. Price 75 sh.

Annual Review of Nuclear Science (Annual Reviews Inc., 231, Grant Avenue, Palo Alto, California, U.S.A.), 1965: Pp. 502: Price \$ 8.50.

Statics of Deformable Solids. By R. L. Bisplinghoff, J. W. Mar and T. H. H. Pian. (Addison-Wesley, Reading, Mass.), 1965. Pp. xii + 322. Price \$ 11.50.

Living Tissues: An Introduction to Functional Histology. By R. L. Holmes. (Pergamon Press, Long Island City, New York), 1965. Pp. xii + 142. Price 15 sh.

Organische Chemie. By R. Muller, H. Furst and W. Kirsten. VEB Verlag Volk und Gesundheit, Berlin), 1965. Pp. 344. 17 MDN.

THE NEW PHYSIOLOGY OF VISION

Chapter XLII. Further Observations with the Neodymium Filter

SIR C. V. RAMAN

THE highly important role played in human vision by the yellow sector of the spectrum emerged very clearly from the studies described in the earlier chapters. Striking demonstrations of this are furnished by the effect of the interposition before the observer's eye of a piece of glass coloured by neodymium oxide which is of just sufficient thickness to exhibit a practically complete cut-off of the spectral region between $570\text{ m}\mu$ and $600\text{ m}\mu$, while in other regions the absorption is relatively much weaker. Preliminary observations made with such a filter have already been described earlier. But it appeared desirable to carry out a more detailed study with its aid and to present the results.

Characteristics of the Filter.—The specimen of neodymium glass used in the present studies was of rectangular shape $3\text{ cm.} \times 2\text{ cm.}$ and had a thickness of 5 millimetres. When held against a white card illuminated by direct sunlight, it appears of a light purplish colour and produces a surprisingly large reduction in intensity of the light transmitted through it. This feature is even more strikingly exhibited when extremely brilliant objects are viewed through it. For example, the dome of an observatory covered over by aluminium paint when lit by direct sunlight appeared almost insupportably brilliant when viewed by the naked eye. But when the eye is protected by the neodymium filter, one can look at the dome and continue looking at it without any discomfort. It is evident from these observations that the part of the spectrum between $570\text{ m}\mu$ and $600\text{ m}\mu$ makes a large contribution to the visual brightness of any object, and that this contribution becomes proportionately much larger when the luminosity of the object goes up to high levels.

Besides the intense absorption in the yellow sector of the spectrum, there are three other regions of absorption; a fairly conspicuous band with well-defined edges in the green sector between $520\text{ m}\mu$ and $545\text{ m}\mu$, a second and feebler band between $510\text{ m}\mu$ and $518\text{ m}\mu$, and finally, a weak absorption in the blue sector between $470\text{ m}\mu$ and $490\text{ m}\mu$. The conspicuously bright regions in the spectrum of the transmitted light are in the greenish-yellow between $545\text{ m}\mu$ and $570\text{ m}\mu$ and in the red from $600\text{ m}\mu$

to the long-wave end of the spectrum. As a substantial part of the yellow sector comes through the filter unabsorbed, it is not surprising that the colour exhibited by the filter in transmitted light is only a light purple. Indeed, the filter might be easily mistaken as being of a neutral tint.

The spectroscopic behaviour of the filter provides an insight into the remarkable effects observed when differently coloured objects are viewed through it. For example, the face of a person having a fair complexion as seen through the filter exhibits a startling blood-shot appearance, evidently as the results of the extinction of the yellow in the light diffused by the human skin. Likewise, when the blue sky is seen through the filter, it appears a deeper blue. Vegetation of a light greenish-yellow colour appears a deeper and darker green. In various books and brochures, one finds illustrations representing the colours in a pure spectrum as seen by the eye. The colours seen in such illustrations are, of course, not actually those of a spectrum, but only imitations thereof. Hence, when viewed through the neodymium filter, they present an altered appearance. As is to be expected, the yellows show a marked diminution in intensity, but no great change in hue. Other colours show changes both in hue and in brightness. Orange, for example, loses brightness and changes to red.

Coloured Silks.—In an earlier chapter, the relationship between the spectral character of the light diffused by dyed silk and the colour exhibited by the material was studied and discussed for a variety of cases. A technique even simpler than spectroscopic examination is to view the silks through colour filters of different sorts and to note the changes in brightness and hue resulting from the introduction of the filter. We are here specially interested in the effects produced by the neodymium filter. But it is instructive to compare these with the effects produced by other colour filters of commoner types, e.g., red, orange, yellow, green; greenish-blue or blue filters. Some thirty different samples of silk were available for the tests. It is convenient for examining them to place them in a row with an ordered colour sequence. This

enables them to be viewed simultaneously and compared with each other.

Of the thirty samples, twenty exhibit highly saturated colours which could be arranged in a pseudo-spectral sequence ranging from dark red to a deep violet, while the ten other specimens were very lightly dyed or else exhibit special colours and could not therefore be placed in such a sequence. These two types will be dealt with separately in what follows. The filters of glass through which the dyed silks were viewed also exhibited saturated colours which formed a pseudo-spectral sequence, *viz.*, red, orange, yellow, green, greenish-blue and blue. The appearance of the silks forming a spectral sequence of colour changed in a significant but not unexpected manner when viewed through this series of filters.

As seen through the red filter, the six silks which range in colour from red to yellow exhibit a brilliancy increasing in that order, in other words, the yellow silk appears the most brilliant. All the other fourteen silks ranging from a light green to a deep violet appear quite dull or dark as seen through the red filter.

Seen through the orange-coloured filter, the yellow silks are still the brightest, while a greenish-yellow silk shows an appreciable brilliancy. The green silks all appear rather dull and dark. The blue-green silks appear of a dull green colour, while all the blue silks appear dull and dark.

Seen through the yellow filter, there is a remarkable increase in the relative brightness of all the green and greenish-blue silks, the latter now appearing of a brilliant green colour. The blue and violet silks remain dark.

As seen through a green filter, there is a notable diminution in the brightness of all the silks ranging from red to yellow in colour. The silks ranging from green to greenish-blue now appear fairly bright, the blue-green silks appearing green in colour. But the silks of a deep blue bright colour remain dull and dark.

Seen through a bluish-green filter, all the silks ranging from red to yellow appear quite dull. The remaining fifteen silks are fairly bright, the blue-greens and blues particularly so.

Seen through a blue filter, all the silks ranging from red to a light green appear very dull or dark. The remaining silks appear fairly bright, the light blue silks being the brightest.

In considering the visual effect produced by the neodymium filter, we have, of course, to take note of the loss of about 10% in luminosity

due to reflection at the two faces of the filter. The effects of the two absorption bands in the green and of the absorption in the blue have also to be considered. These absorptions diminish the contributions to luminosity made respectively by the green and the blue regions in the spectrum. Even taking account of all these features, however, the effect due to the elimination of the part of the spectrum in the wavelength range from $570\text{ m}\mu$ to $600\text{ m}\mu$ is so conspicuous that it can be recognised in most cases. The change in the visible colour produced by this absorption is specially evident in the case of the scarlet, orange, orange-yellow, yellow, and light green silks. The diminution in brightness produced by it is particularly conspicuous in the case of the orange-yellow, yellow, yellowish green and green silks.

Rose-Coloured Silks.—Three samples of dyed silk exhibiting a rose-red colour and differing in the depth of that colour were available; one of them was a dark rose-red, the second was of a brighter hue and third a brilliant pink. Very remarkable changes both in brightness and in hue manifested themselves when these specimens were viewed successively through the six colour filters of the series, the three samples differing notably amongst themselves. The observations show in a more spectacular fashion what spectroscopic study reveals as the origin of the rose-red or pink colours, *viz.*, the presence of the red and blue sectors in considerable strength and a nearly complete absorption of the green and yellow sectors. Observed through the neodymium filter, the samples manifest changes both in colour and in brilliancy. But these are not of a particularly striking nature.

Metallic Colours.—There are many cases in which superficial colour is manifested by reason of the variation of the opacity of the material to light over the range of the visible spectrum. The colours exhibited by the polished surfaces of metals and metallic alloys may be cited as examples. The yellow colour of gold and the red colour of copper are the best known illustrations amongst the pure metals, while brass, bronze and many other examples of metallic alloys could be mentioned. In all these cases, both the lustre and the colour of the polished surfaces exhibit striking changes when viewed through the neodymium filter. Gold appears duller, and of an orange-yellow hue, while copper assumes a deeper red colour than is normally the case.

PHYTOTOXICITY*

T. S. SADASIVAN

University Botany Laboratory, Madras-5

THE role of chemicals in altering metabolism at critical biological sites is a current segment of research in the study of plant chemotherapy. The implied concept of phytotoxicity needs hardly any justification since the success of any chemotherapeutant rests on the selective toxicity of the chemical or, any products of its conversion to the pathogen, the ease of its absorption and translocation and, more important of all, its freedom from causing inhibitory effects on plant growth. Although a wealth of literature exists on the application and effectiveness of a variety of chemicals and their selective toxicity to macro and micro-organisms in pest and disease control,¹⁻³ there is urgent need for fundamental information on the alterations induced at cellular and subcellular sites on the inhibition so often noticed in plant vigour and growth following a chemical treatment. Many pesticide, insecticide and fungicide schedules are now known to alter soil-plant rhizosphere interactions,⁴ membrane permeability, translocatory and transpiratory processes, induce changes in oxygen and ion uptake, intrude on enzyme-substrate-energy involving reactions, affect photosynthesis, nucleic acid and protein synthesis. It is, therefore, obvious that studies on crop physiology and factors governing the role of individual chemicals and groups of compounds used in soil or spray schedules on plants are essential to properly evaluate phytotoxic effects which may vary with the habitat, meteorological and soil conditions. These aspects are, therefore, discussed here in the context of the growing necessity for introspection in crop management practices with particular reference to the use of proprietary fungicides.

Recent experiments on Flax⁵ with the triethanolamine salts of 2:4-dichloro-, 2:4:5 trichloro-, and 2-methyl-4-chlorophenoxy acetic acids (which are freely translocated when sprayed on leaves or applied in droplets on cotyledons) have shown marked inhibition of growth rates with increasing concentration of application. The order of inhibition due to these substituted phenoxy acetic acids was shown to depend on the absolute amount deposi-

ted on the shoots and that overall phytotoxic effects are dependent on the type of compound. Work with shoots of peas⁶ has shown that these are readily damaged when high Monuron [3-(p-chlorophenyl)-1, 1-dimethylurea] concentrations were applied for even short periods of time especially under conditions of high metabolic activity. Pronounced growth inhibition in tomato, cucumber, strawberry and carrots due to soil application of insecticides such as DDT, Dieldrin and Aldrin have been reported.⁷ Chlorinated hydrocarbon insecticides such as these are frequently used to control soil-borne pests of horticultural and agricultural crops. When applied frequently these very stable and persistent chemicals may eventually accumulate in many soils. The residual effects of these on plants grown in treated soils is little studied, despite observations that they can seriously injure growth.⁸⁻¹⁵ Studies on alkyl and aryl substituted ureas and thioureas⁶ whose toxicity to peas was shown to be a function of their solubility in water have indicated the possibility that these chemicals may affect enzymatic processes by distortion of sites at which integrated reactions occur in cells. In discussing the toxicities of physical poisons such as the ureas substituted with acidic or basic groups and related compounds, Hassall¹⁶ pointed out that growth inhibition stems mainly from changes in lipoprotein phase boundaries in cells whether the site of action is the chloroplast, the mitochondrion or the cell membrane. Coumarin, whose phytocidal properties have been described by Audus and Quastel¹⁶ was shown to inhibit water uptake by altering the permeability of the protoplasm in embryonal cells in wheat seed.¹⁷ Similarly, loss in permeability of tissues with toxæmia has also been reported from this laboratory¹⁸ with fusaric cottons. This vivotoxin, formed *in situ*, and highly stable in the rhizosphere of crop plants can impair membrane permeability at even very low concentrations (10^{-9} to 10^{-8} M). Its preferential avidity for Fe may also cause the removal of this metal from porphyrin moieties as was shown here in *in vivo* studies.¹⁹ These primary changes in osmoregulation of host cells following toxæmia is also evidenced by an increased conductivity and accumulation of electrolytes in cotton plants.²⁰ Further, spectrochemical analyses clearly indicated ionic

*Text of Lecture delivered to Section B of the Indian Academy of Sciences at the Osmania University in December, 1965. Memoir No. 20 from the Centre for Advanced Studies in Botany.

imbalance in infected leaves, increased tissue contents of Mg, Ca and Mn²¹ and pronounced increase in oxygen uptake.²²

Studies on the passage of fungicides through the relatively complex chemical and osmotic barriers in higher plant tissues have also shown that active transport across cells is influenced by the type of chemical, the solvent used, dosage, area of application and the relative humidity. Experiments with a new class of fungicides belonging to the class of β -amino-ethyl-aril-ketones on bean and tobacco have shown that penetration through roots and stems and translocation to leaves of C¹⁴ labelled substances occurs relatively quickly.²³ Although the potential usefulness of this in the control of bean rust caused by *Uromyces* spp. was considered by them as obvious, it was pointed out that systemic migration of these compounds occurs not only into a restricted area of the treated leaf but also into the upper parts of the plant as shown by autoradiography of treated plants 3 days after application of S 210-C¹⁴ in aqueous solution. In leaves, passive diffusion through cuticle and epidermis into different areas of palisade and spongy mesophyll also occur independently of the vascular mass flow. This idea of the non-specific permeation mechanism which may depend on the solubility of substances in membrane components of cells stimulates thought on the possible presence and location or absence of sensitive reaction sites through which an agent can cause phytotoxic effects in inhibiting normal plant growth. An example of this is afforded by the mechanism of action of chloramphenicol. This lipid-soluble antibiotic, produced by species of *Streptomyces venezuelae*, is generally absorbed by plant roots and translocated to leaves.²⁴ It inhibits protein synthesis in bacteria but not fermentation, respiration or nucleic acid synthesis.^{25,26} At concentrations ten times higher than are effective in bacteria (200 μ g./ml.) protein synthesis in cell-free preparations of particles from higher plants is sensitive to chloramphenicol.²⁷ At still higher concentrations (1000 to 2000 μ g./ml.) it inhibits salt uptake by red beet slices and carrot root tissue without significantly altering respiration.²⁸ Phosphorylation and respiration are not affected by chloramphenicol in normal mitochondrial preparations,²⁹ and as shown from the work of Webster³⁰ and Jacoby and Sutcliffe³¹ on carrot slices, it has been assumed that chloramphenicol blocks the incorporation of amino-acids into nucleoproteins. Steward and Miller³² earlier reported on a

close relationship between the process of salt accumulation and protein synthesis. Uhler and Russell³³ working on barley have shown that chloramphenicol retarded the accumulation of Ca and Ru significantly although transpiration was little affected. Jacoby and Sutcliffe³¹ suggest that the incorporation of amino-acids into proteins proceeds by at least two mechanisms in carrots and that one of these is chloramphenicol-sensitive and related to protein synthesis while the other unrelated to protein synthesis is insensitive to the action of this drug. It then became necessary to clarify the effect of chloramphenicol on inorganic ion absorption and to elucidate the relation between salt absorption and protein synthesis. Thus, studies on phytotoxicity of chloramphenicol, long known to be an inhibitor of protein synthesis, have paved the way to its implication in processes affecting salt uptake and the mechanisms of active transfer which convey ions across root membranes.

Permeability changes such as those described here can have far-reaching effects on soil plant relationships especially in tropical soils which differ from temperate ones in their ability to hold and supply nutrients.³⁴ Even on the broadest basis soils in many areas of the tropics are subject to more intense weathering processes and leaching of plant nutrients. Unproductive plant growth induced by pesticidal and fungicidal schedules are, therefore, naturally to be viewed with concern. Quite obviously, indiscriminate chemical schedule might do great harm if a move is made to copy soil or spray practices of chemical toxicants evolved in temperate environs for a totally different tropical climate where rapid translocatory, photosynthetic and, in general, accelerated metabolic rates prevail more commonly in plants subjected to high temperature variations. Little is known about the toxicities of recalcitrant insecticide, herbicide and fungicide molecules whose persistence and accumulation in soils from frequent application may eventually assume phytocidal proportions.

Several herbicides such as 2, 4-D (2, 4-dichlorophenoxyacetic acid), Dalapon (2, 2-dichloropropionic acid), TCA (trichloroacetic acid) can persist for 2 to 8 weeks while Monuron [3-(*p*-chlorophenyl)-1, 1-dimethyl urea], 2, 4, 5-T (2, 4, 5-trichlorophenoxyacetic acid) persist for 4 months to almost one year. Insecticides such as benzene hexachloride and chlordane are known to persist for more than ten years. Ethylene dibromide, dichloropropene-dichloropropane mixture and dibromochloropropane are

often applied as nematocides. Chloropicrin and methylbromide are used both as nematocides and fungicides. Formaldehyde, Captan (N-trichloromethyl thio-1, 2, 3, 4-tetrahydro thalimide), Thiram (tetramethylthiurum disulphide), Nabam (disodium ethylenebis dithiocarbamate) and other dithiocarbamates such as Ziram, Maneb, Ferbam, chlorinated quinones like Chloranil (Spergon), Dichlone (Phygon) are used as fungicides. Very little is known concerning the microbiological detoxication of many of these fungicides and insecticides.³⁵

The degree and duration of phytotoxicity with herbicides such as the phenoxyalkyl-carboxylic acids, substituted ureas, nitrophenols, chlorinated acetic and propionic acids, phenyl-carbamates and thiocarbamates used in weed control, turf and crop management is not known.³⁵

Pesticides, many of which are not easily decomposed in soil can act on the saprophytic soil colonizers and prove inimical to plant growth. Seed dressings with organo-mercurials and compounds that inhibit fungal growth can prevent the normal colonization of nitrogen-fixing bacteria in the legume rhizosphere. DDT, BHC, Chlordane, Aldrin, Dieldrin, Parathione and Toxaphene may affect nitrification and legume nodule formation. Thiram, Diclone, Chloranil and Captan are toxic to rhizobia. Chloropicrin interferes with ammonification.³⁵

It is, therefore, hardly possible to overlook the ability of these antimicrobial agents for they can inhibit biological systems of one kind or another.

Work in this laboratory on the effects of 8-hydroxyquinoline, EDTA, Thiourea, p-Nitrophenol, Sulphanilamide and Griseofulvin on rice seedlings showed that these are phytotoxic to rice.³⁶ Sulphanilamide and Griseofulvin induced characteristic alterations in the soluble nitrogen compounds of varieties of *Oryza sativa* susceptible and resistant to helminthosporioses.

Results of many metabolic investigations indicate a relationship between changed water relations and alterations in metabolic processes following fungicide treatment. Sodium trichloroacetic acid was shown to inhibit both respiration and photosynthesis in tomatoes.³⁷ Studies with three new compounds E52, E54 and CH showed blocking of respiration and inhibition of photosynthesis to varying degrees.³⁷ Substituted ureas and carbamates at concentrations lower than those affecting cell division suppressed photolytic reaction in isolated chloroplasts.⁶ Urea, Ethylurea, Monuron, Thiourea, Ethylthiourea and Ethylcarbamates act as physical

poisons with varied toxic effects on living organisms.⁶ Fungicides such as Cycloheximide, Dyrene and Zineb affect the synthesis of chlorophyll, deoxyribonucleic acid and ribonucleic acid.³⁸ Phytotoxicity due to Cycloheximide was shown to be more severe on well-grown rather than on poorly-grown onion plants. Dyrene in addition induced decreased levels of DNA in leaves of onions. While DNA synthesis was inhibited by these fungicide sprays RNA synthesis was increased abnormally following sprays with Cycloheximide. The decrease in chlorophyll content was more marked in younger leaves than in older ones. Although there were no differences in dry matter, ash and water contents of treated and control leaves, fungicides clearly influenced the synthesis of DNA and RNA. Similarly, the antiblast antibiotic Blasticidin S was shown to cause a marked accumulation of RNA in yeast even at as low a concentration as 1 p.p.m.³⁹ At excessive concentrations (40 µg./ml.) Blasticidin was phytotoxic to rice, soybean, apple, pear, peach, cabbage, cucumber, tomato and other plants. Inhibition of cell division by 6-methyl purine was shown to occur *in vitro* in pith and callus cells even at 10^{-9} M, while complete inhibition of cell division accrued with 10^{-6} M.⁴⁰ Aflatoxins produced by moulds (*Aspergillus* spp.) similarly suppress cell division and the synthesis of even the genetic material DNA.⁴¹

A curious sidelight of the effects of these toxins has recently come to light on studies with the aflatoxins produced by common species of *Aspergilli*. The generally observed non-fatal but weakening and debilitating effects which are generally considered inevitable due to living conditions in the tropics leading to the often prevalent lassitude of tropical man is now really considered simply an effect of eating mouldy foodstuffs containing these aflatoxins.

Indeed, the problem of phytotoxicity needs tackling not only in the area of alterations in metabolic patterns in plants under chemotherapeutic stress but also on the role of mould-produced poisons as well in abnormal growth.

1. Owens, R. G., *A Rev. Phytopath.*, 1963, **1**, 77.
2. McCallan, S. E. A., Hamilton, J. M. and Mills, W. D., In *Plant Pathology, Problems and Progress*, 1908-1958, Part IV. Univ. of Wisconsin Press, 1969, p. 219.
3. Goring, C. A. I., in *Recent Progress in Microbiology, Int. Congr. Microbiol., Montreal*. Univ. of Toronto Press 1962, p. 257.
4. Kreutzer, W. A., *A Rev. Phytopath.*, 1963, **1**, 101.
5. Blackman, G. E., Bruce, R. S. and Holly, K., *J. exp. Bot.*, 1958, **9**, 175.

6. Hassall, K. A., *J. exp. Bot.*, 1961, **12**, 47.
7. Dennis, E. B. and Edwards, C. A., *Pl. Path.*, 1964, **13**, 173.
8. Foster, A. C., *Circ. U.S. Dep. Agric.*, 1951, No. 862, p. 41.
9. Stone, M. W., Foley, F. B. and Bixby, D. H., *Ibid.*, 1953, No. 926, p. 19.
10. Allen, N., *Tech. Bull. U.S. Dep. Agric.*, 1954.
11. Morrison, H. E., Crowell, H. H., Crumb, Jr., S. E. and Lauderdale, R. W., *J. econ. Ent.*, 1948, **41**, 374.
12. Cox, H. C. and Lilly, J. H., *Ibid.*, 1952, **45**, 421.
13. Wheatley, G. A., Hardman, J. A. and Strickland, A. H., *Pl. Path.*, 1962, **11**, 81.
14. Dennis, E. B. and Edwards, C. A., *Ibid.*, 1961, **10**, 54.
15. — and —, *Ibid.*, 1963, **12**, 27.
16. Audus, L. J. and Quastel, L. H., *Nature, Lond.*, 1947, **159**, 320.
17. Blaim, K., *J. exp. Bot.*, 1960, **11**, 377.
18. Sadasivan, T. S., *A Rev. Pl. Physiol.*, 1961, **12**, 449.
19. Malini, S., *Experientia*, 1960, **16**, 496.
20. Gnanam, P., *Proc. Indian Acad. Sci.*, 1956, **44 B**, 125.
21. Sadasivan, T. S. and Kalyanasundaram, R., *Ibid.*, 1956, **43 B**, 271.
22. Lakshmanan, M., *Phytopath. Z.*, 1959, **36**, 406.
23. Pellegrini, G., Bugiani, A. and Tenerini, L., *Ibid.*, 1965, **52**, 37.
24. Crowdy, S. H., *Ann appl. Biol.*, 1957, **45**, 208.
25. Gale, E. F. and Folkes, J. P., *Biochem. J.*, 1953, **53**, 493.
26. Ycas, M. and Brawerman, G., *Archs Biochem. Biophys.*, 1957, **68**, 118.
27. Rabson, R. and Nqvelli, G. D., *Proc. natn. Acad. Sci. U.S.A.*, 1960, **46**, 484.
28. Sutcliffe, J. F., *Nature, Lond.*, 1960, **188**, 94.
29. Loomis, W. F., *Science, N.Y.*, 1950, **111**, 471.
30. Webster, G. C., *J. Biol. Chem.*, 1957, **229**, 535.
31. Jacoby, B. and Sutcliffe, J. F., *J. exp. Bot.*, 1962, **13**, 335.
32. Steward, F. C. and Miller, F. K., *Symp. Soc. exp. Biol.*, 1954, **8**, 367.
33. Uhler, R. L. and Russell, R. S., *J. exp. Bot.*, 1963, **14**, 431.
34. Vageler, P., *An Introduction to Tropical Soils*, Macmillan and Company, London 1933.
35. Alexander, M., *Introduction to Soil Microbiology*, John Wiley and Sons, 1961, p. 227.
36. Srivastava, S. N. S., "Systemic Fungicides and Host-parasite Response," *Ph.D. Thesis*, Univ. of Madras, 1964.
37. Krihning, J., *Phytopath. Z.*, 1965, **53**, 241.
38. Shishiyama, J., Fukutomi, M. and Akai, S., *Phytopathology*, 1965, **55**, 814.
39. Hashimoto, K. and Misato T., *J. Antibiot., Tokyo*, 1965, **18**, 77.
40. Chen, H. and Galston A. W., *Pl. Cell Physiol., Tokyo*, 1965, **6**, 365.
41. Anon, *New Scientist*, 1966, **29**, 352.

RADIOCARBON DATES OF SAMPLES FROM HISTORICAL LEVELS

D. P. AGRAWAL, S. KUSUMGAR AND M. UNNI KRISHNAN

Tata Institute of Fundamental Research, Colaba, Bombay-5

IN this paper we present radiocarbon "dates" of samples from a few historical sites—the important ones among them being Ahichchhatra, Besnagar, Dharnikota and Nagara. The experimental procedures are described briefly below; details have been described earlier (Kusumgar et al., 1963; Agrawal et al., 1965).

Samples were first cleaned manually to remove extraneous matter (rootlets, earth, etc.). Carbonates, if present, were removed by digesting samples in 1% HCl. Any humic acid present was removed by treating the samples with NaOH. In the case of samples composed of soft material, this step was avoided, lest they disintegrate. Samples were counted in the form of CH_4 in gas proportional counters. Ninety-five per cent activity of N.B.S. oxalic acid is used as modern reference "standard".

Each sample is accompanied by two dates in years B.P.: the first is based on the C^{14} half-life value of 5568 ± 30 yrs.; the second, within parenthesis, on 5730 ± 40 yrs. The latter may be used as the best working value (Godwin, 1962). The same half-life should be used for all intercomparisons. A.D. 1950 should be used

as reference year for conversion of B.P. dates to A.D./B.C. scale.

GENERAL COMMENT ON DATES

C^{14} dates for the fortifications of Ahichchhatra and Dharnikota (this date list) and Rajgir (TF-46 and TF-45) show that earliest historical fortifications do not seem to go beyond 2nd-3rd century B.C. Bainapalli sample TF-530 may indicate that the end of the southern megaliths goes to 3rd-4th century B.C. More dates for the megaliths of the south are needed to determine their time-spread. An "Asura" culture site has been dated, for the first time, to the beginning of Christian era.

ACKNOWLEDGEMENTS

We are grateful to Prof. D. Lal and Dr. Rama for their guidance throughout this work. Thanks are also due to Shri S. G. Lele for efficiently carrying out changes and repairs in the glass-vacuum system.

C^{14} DATES WITH SAMPLE DESCRIPTIONS

Ahichchhatra, Uttar Pradesh, India

Ahichchhatra (Lat. $28^\circ 22' \text{N}$, Long. $79^\circ 7' \text{E}$), District Bareilly, was the capital of north

Panchal. The site has been excavated by Dr. N. R. Banerji. Samples were submitted by Shri A. Ghosh, Archaeological Survey of India.

TF-301, Defences, 2255 \pm 105
(2320 \pm 105)

Charcoal from Locus CXIII-CXIV, Layer 1, Depth 0.8 m., Field No. 2 (Defences). Viable rootlets were handpicked. NaOH pretreatment was given. Comment: the sample was found in the debris just above the mud-filling belonging to phase II of the early historic Defences.

TF-317, Late P.G. Ware Deposits (?), 2155 \pm 100
(2220 \pm 105)

Charcoal from high mound, Locus X-XI, Layer 15, Depth 3.4 m., Field No. 214 (H.M.). Comment: sample belongs to disturbed strata.

Baghaikhor, Uttar Pradesh, India

TF-187, Rock Shelters, 270 \pm 120
(280 \pm 125)

Charcoal from Baghaikhor, District Mirzapur, Trench BGK-Tr. 2, Locus 2-3, Pit A, sealed by Layer 1, Depth 0.1 m., Field No. BGK(M)-63/3001. NaOH pretreatment was given. Sample submitted by Prof. G. R. Sharma. Comment (G. R. S.): as these shelters have been used to light fires by shepherds till modern times, later intrusions cannot be ruled out. This charcoal is obviously of much later time.

Bainapally, Madras, India

TF-350, Post-megalithic Period, 2265 \pm 100
(2330 \pm 105)

Charred grain from Bainapally (Lat. 12° 33' N., Long. 78° 27' E.), District North Arcot, Trench BNP-1, Locus C₁, Pit 4, sealed by Layer 3, Depth 1.30 m., Field No. BNP1-C₁/64-2. Submitted by Shri A. Ghosh. Viable rootlets were handpicked.

Besnagar, Madhya Pradesh, India

TF-387, N.B.P. Ware Deposits, 2350 \pm 100
(2420 \pm 105)

Charcoal from Besnagar (Lat. 23° 32' N., Long. 77° 48' E.), District Vadisha, BSN-4, Locus G1, Layer 8, Depth 3.00 to 3.15 m., Field No. 1850. Submitted by Shri A. Ghosh.

Bhaja, Maharashtra, India

TF-245, Buddhist Rock-Excavations, 75 \pm 90
(75 \pm 90)

Wood from Bhaja Rock-Excavations. (Lat. 18° 44' N., Long. 73° 29' E.), District Poona, Field No. AR-11. Submitted by Shri A. Ghosh. Comment: the sample appears to be derived from a recent repair.

Dharnikota, Andhra Pradesh, India

Dharnikota (Lat. 16° 34' 45" N., Long. 80° 24' 21" E.), District Guntur, is an early historic site near Amravati. Excavations were conducted by Shri Venkataramayya and samples submitted by Shri A. Ghosh.

TF-248, Fortifications, 2095 \pm 100
(2155 \pm 100)

Charcoal from Trench DKT-1, Locus XXXVI-XXXIX, Layer 10, Depth 6 m., Field No. DKT-1/63/No. III. Comment: sample will date the Satavahana fortifications.

TF-247, Early Historic Period, 2275 \pm 100
(2340 \pm 100)

Charcoal from Trench DKT-2, Locus A₂-A₃, Layer 8, Depth 3.7 m., Field No. DKT-2 (63) No. 1. NaOH pretreatment was also given.

Karla, Maharashtra, India

TF-185, Buddhist Rock-Excavation, 2180 \pm 95
(2245 \pm 95)

Wood rib from Karla (Lat. 18° 45' N., Long. 73° 29' E.), District Poona, Chaitya Cave No. 8. NaOH pretreatment was also given. Sample submitted by Shri A. Ghosh.

Mainahai, Uttar Pradesh, India

TF-347, Historical Levels, 1420 \pm 95
(1460 \pm 95)

Charcoal from Mainahai (Lat. 25° 21' N., Long. 81° 25' E.), District Allahabad, Trench MNH/BWN-1, Locus 0-3, Layer 6 N, Depth 0.75 m., Field No. MNH/64/901. NaOH pretreatment was also given. Sample submitted by Prof. G. R. Sharma. Comment: the sample will date historical sculptures discovered at the site.

Morahana Pahar, Uttar Pradesh, India

TF-188, Rock-shelter Deposits, 1530 \pm 95
(1575 \pm 100)

Charcoal from Morahana Pahar, District Mirzapur, Trench MRA, Locus 1-2, Pit A, sealed by Layer 1, Depth 0.09 m., Field No. MRA(M)-63/3002. NaOH pretreatment was given. Sample was submitted by Prof. G. R. Sharma. Comment (G. R. S.): as these shelters have been used by shepherds till modern times to light fires, later intrusions cannot be ruled out.

Nagara, Gujarat, India

Nagara (Lat. 22° 41' 15" N., Long. 72° 38' 31" E.), District Kaira, is a historical site. It is being excavated by Dr. R. N. Mehta, M. S. University,

Baroda, who submitted the samples. Comment: C^{14} dates agree with the excavator's archaeological estimates.

TF-362, Period III, 1945 \pm 90

(2000 \pm 90)

Charcoal from Trench NGR-II, Locus III, Layer 13, Depth 3.30 m., Field No. 1947. NaOH pretreatment was also given.

TF-364, Period III, 2030 \pm 100
2085 \pm 105

Charcoal from Trench NGR-II, Locus III, Layer 16, Depth 4.40 m., Field No. 1949.

Saradkel, Bihar, India

TF-369, Asura Culture, 1910 \pm 90
(1970 \pm 90)

Charcoal from Saradkel (Lat. 23° 3' 30" N., Long. 85° 21' E.), District Ranchi, Trench SDK-2, Locus C₃-C₄, Layer 3, Depth 0.01 m. (?), Field No. SDK-2/65-114. NaOH pretreatment was given. Sample submitted by Shri A. Ghosh. Comment: red ware sprinklers are associated with these deposits.

1. Agrawal, D. P., Kusumgar, S. and Lal, D., *Curr. Sci.*, 1965, **34**, 394.
2. Godwin, H., *Nature*, 1962, **195**, 984.
3. Kusumgar, S., Lal, D. and Sharma, V. K., *Proc. Ind. Acad. Sci.*, 1963, **58**, 125.

A NEW FORM OF *ORYZA* FROM CHINA

S. SAMPATH AND M. D. SUBRAMANYAM

Central Rice Research Institute, Cuttack-6

FOR tracing evolution and relationship in the genus *Oryza* a large collection of species and varieties are maintained in the Central Rice Research Institute. In this collection, variations amongst *Oryza officinalis* Wall. from different localities in Asia are interesting. There is evidence of sub-species formation in this species as shown by morphological differences as well as hybrid sterility. For instance Morinaga and Kuriyama (cited by Kihara¹) found complete seed sterility in intervarietal hybrids of *O. officinalis* in six cross combinations. Another instance is a Ceylon collection which has been inferred by Karibasappa² to be classifiable as *O. officinalis* on morphological and cytological characters while Sharma and Shastri³ designate it as a distinct species.

One collection of seeds labelled as *O. officinalis* No. W. 0553 was secured from National Institute of Genetics, Misima, as being collected from China. Previously a sample from this collection had shown some distinctive characters and therefore this was secured again, grown, and the novelty was confirmed.

The plants resemble varieties of *O. officinalis* in general appearance, in the presence of short woody rhizomes, in panicle branching and also in the appearance of spikelets. The spikelets have the size, shape and lemma sculpturing characteristic of the section *Latifoliae* of the genus. The resemblances are shown in Fig. 1 where seeds of four species in this section are arranged on either side of the new species

and it can be seen that it resembles the seeds of *O. latifolia*.

The important difference between this Chinese form and *O. officinalis* is in its chromosome number. Smears of P.M.C. showed it to be a tetraploid, 24 bivalents being present in all the cells, while all examined varieties of *O. officinalis* are diploids ($N=12$). The ligules of well-grown leaves in this collection show moderate fringing (hairs) and this feature is generally absent in *O. officinalis*, while this fringing is conspicuous in *O. latifolia* and related American species. This feature in the Chinese form is compared with Asian *O. officinalis* and American *O. latifolia* in Fig. 2.

It is possible that the form under study had evolved in China by hybridisation between two sub-species of *O. officinalis*, accompanied by chromosome doubling. A parallel instance is known from India. A tetraploid species closely resembling *O. officinalis* has been collected from Malampuzha in Kerala, and Gopalakrishnan⁴ has elucidated its relationships.

Since this form closely resembles *O. latifolia* of America in chromosome number, ligule fringing, tall growth (190 cm.), broad leaves (3.2 cm.), as well as in well-developed auricles, an alternative explanation must be considered. It is unlikely, but by accident seeds of *O. latifolia* could have contaminated the culture of this sample in green house in Japan, and had been propagated. A direct check is not possible since the locality from which it was collected is not known, and could be in Mainland China.

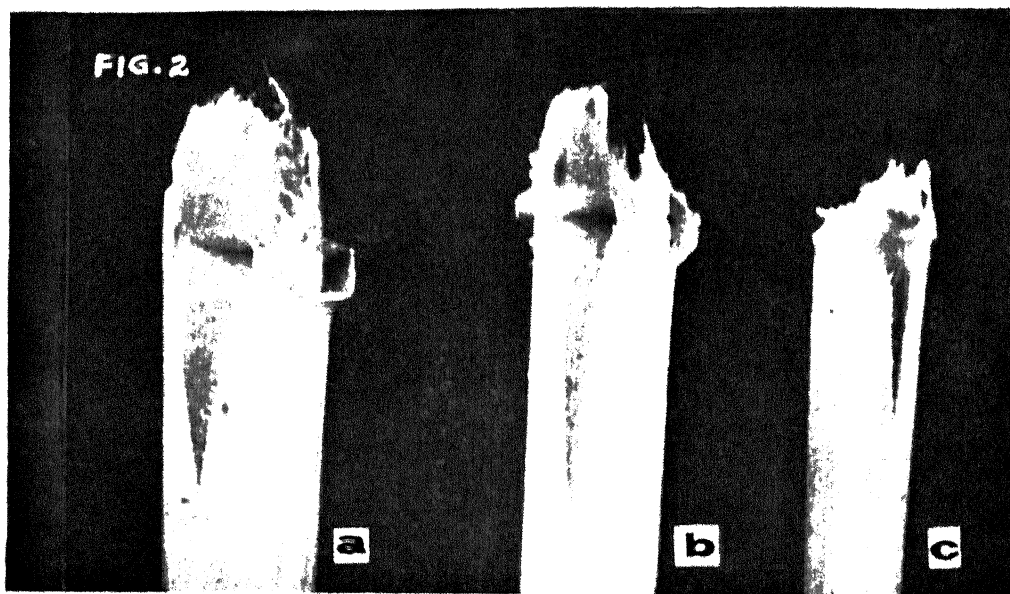
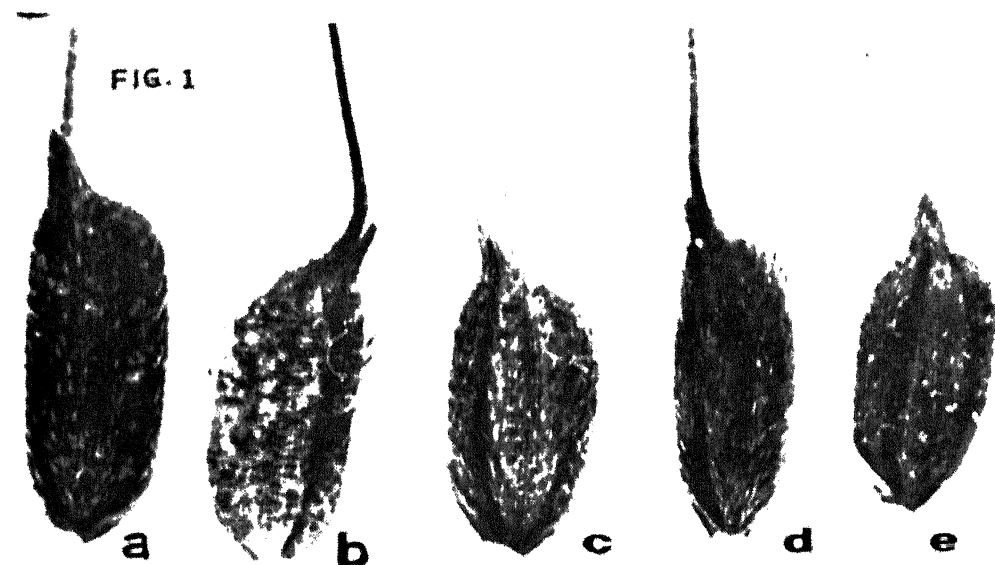


FIG. 1-2. Fig. 1. Spikelets of (a) *O. sativa*, Africa; (b) *O. latifolia*, America; (c) Chinese species; (d) *O. sativa*, Africa and (e) *O. sativa*, Gujarat. Fig. 2. Ligules of (a) *O. latifolia*; (b) Chinese species; and (c) *O. sativa*, Gujarat.

direct check by hybridisation with *O. latifolia* or with the Malampuzha tetraploid in being one.

We acknowledge the facilities and assistance given to this study by the Director, Central Rice Research Institute.

1. Kihata, H., *J.R.C. Newsletter*, *Fourth Ex. 9, Nippon, Congress Symposium on Rice Problems*, 1963, p. 57.
2. Karlesappa, D. K., *Oryza*, 1962, 1, 85.
3. Sharma, S. D. and Shastri, S. V. S., *Ind. J. Genet.*, 1965, 25, 168.
4. Gopalakrishnan, R., *Ibid.*, 1961, 20, 108.

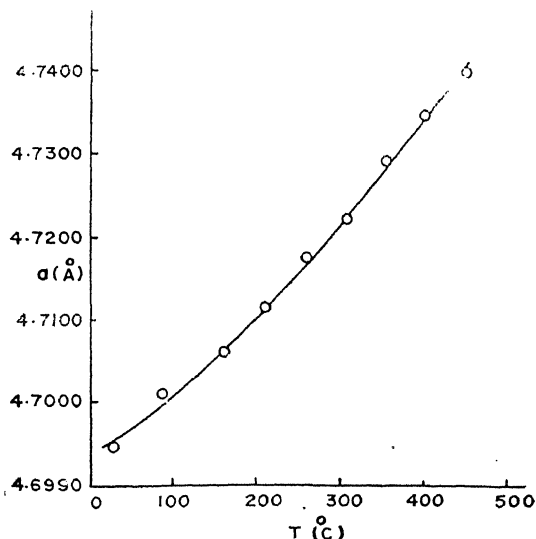
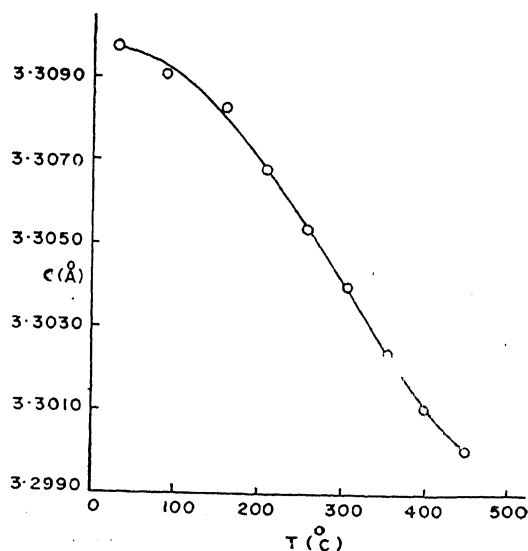
LETTERS TO THE EDITOR

ANOMALOUS THERMAL EXPANSION
OF FERROUS FLUORIDE

IN a recent publication¹ from this laboratory, while describing the results on the thermal expansion of cobalt fluoride (CoF_2), it has been mentioned that the behaviour of CoF_2 is peculiar in having the value of the coefficient of thermal expansion perpendicular to the c -axis (α_{\perp}) greater than the coefficient along the c -axis (α_{\parallel}), unlike other rutile type compounds for which α_{\parallel} is greater than α_{\perp} . Hence it is thought worthwhile to study the thermal behaviour of ferrous fluoride (FeF_2), a similar compound. The present communication gives the results on the thermal expansion of FeF_2 .

The sample used in this study has been obtained from Prof. Stout of the University of Chicago. Sharp powder lines with Bragg angles ranging from 61° to 83° , obtained with a Unicam 19 cm. high temperature powder camera and iron radiation from Raymax-60 X-ray unit, have been used for evaluating the lattice parameters. The experimental technique employed is the same as that described in an earlier paper.² The lattice parameters, obtained at different temperatures in the range 25°C . to 450°C ., are given in Table I and shown

graphically in Figs. 1 and 2. The coefficients of thermal expansion at different temperatures are given in Table II.

FIG. 1. Variation of a with temperature.FIG. 2. Variation of c with temperature

It may be mentioned that the behaviour of FeF_2 is very abnormal in having a large value for α_{\perp} and negative value for α_{\parallel} . Recently Haefner³ studied the thermal expansion of FeF_2 from 10°K to 290°K and found that α_{\parallel} is positive throughout this range, whereas α_{\perp} is

TABLE I

Lattice parameters of FeF_2 at different temperatures

Temp. $^\circ\text{C}$.	a (\AA)	c (\AA)
28	4.6945	3.3097
87	4.7009	3.3091
161	4.7060	3.3083
210	4.7113	3.3068
258	4.7173	3.3054
306	4.7221	3.3040
354	4.7289	3.3024
401	4.7344	3.3011
449	4.7397	3.3001

TABLE II

α_{\parallel} and α_{\perp} of FeF_2 at different temperatures

Temp. $^\circ\text{C}$.	$\alpha_{\parallel} \times 10^6$	$\alpha_{\perp} \times 10^6$
50	-1.51	17.57
90	-3.25	18.64
130	-4.98	19.86
170	-6.57	20.98
210	-7.86	22.05
250	-8.84	23.70
290	-9.29	24.87
330	-9.82	26.09
370	-10.05	27.53
410	-10.35	27.96

negative between 10° K and 80° K and positive from 80° K to room temperature. Another rutile type compound having a negative $\alpha_{||}$ is chromium dioxide (CrO₂).⁴ A detailed paper correlating the coefficients of thermal expansion with the other physical properties of rutile type compounds including FeF₂ will be published elsewhere.

In conclusion, the authors wish to thank the C.S.I.R., New Delhi, for sponsoring a Research Scheme, of which this investigation forms a part.

Physics Department,
Osmania University,
Hyderabad-7.
April 5, 1966.

K. V. KRISHNA RAO.
S. V. NAGENDER NAIDU.
MISS LEELA IYENGAR.

1. Krishna Rao, K. V. and Nagender Naidu, S. V., *Proc. Ind. Acad. Sci.*, 1963, **58**, 296.
2. —, — and Setty, P. L. N., *Acta Cryst.*, 1962, **15**, 528.
3. Haefner, K., Private Communication, 1964.
4. Siratori, K. and Iida, S., *J. phys. Soc. Japan*, 1962, **17**, Suppl. B-I, 208.

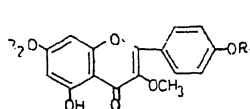
SYNTHESIS OF 3, 7-o-DIMETHYL KAEMPFEROL AND 3, 7, 8-o-TRIMETHYL HERBACETIN

In connection with the study of the constitution of glycosides, several partial methyl ethers of flavonols have been needed. Many of these also occur free in nature. As part of this programme, we have now synthesised the compounds mentioned in the title, which have been found to be the components of a *Beyeria* species and *Ricinocarpus stylosus* respectively by Jefferies *et al.*^{1,2} The structures were assigned on the basis of methylation studies and alkali fission. Further support was provided by U.V. and N.M.R. studies. No synthetic confirmation has been provided. Like calycopterin occurring in the anthelmintic drug *Calycopteris floribunda*, they have the 5 and 4'-hydroxyls free.

The synthesis of o-dimethyl kæmpferol (I) starts from o-methoxy phloracetophenone which was subjected to Allan-Robinson condensation with the anhydride and the sodium salt of p-benzyloxy benzoic acid. The flavonol (III)³ thus obtained was partially methylated in the 7-position. The resulting methyl ether (IV), m.p. 131-32°, was subjected to catalytic debenzoylation to get the desired flavonol (I), m.p. 252-53° (lit.¹ 253-54°); mixed m.p. with natural sample was undepressed; UV spectra were identical.

o-Trimethyl herbacetin (II) has been synthesised starting from 2, 4-dihydroxy-o-3, 6-trimethoxy acetophenone⁴ which was subjected to Allan-Robinson condensation with the

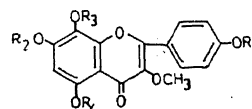
anhydride and the sodium salt of p-benzyloxy benzoic acid. The flavonol (V) thus obtained, m.p. 247-49°, was fully methylated and the resulting methyl ether (VI), m.p. 134-35°, was subjected to catalytic debenzoylation. The resulting tetramethyl ether (VII), m.p. 262-63°, was partially demethylated using aluminium chloride in acetonitrile to give the desired flavonol (II), m.p. 267-68° (lit.² 266-68°); mixed m.p. with natural sample was undepressed and UV spectra were identical.



I, R₁ = H; R₂ = CH₃

III, R₁ = C₇H₇; R₂ = H

IV, R₁ = C₇H₇; R₂ = CH₃



II, R₁ = R₂ = H; R₃ = CH₃

V, R₁ = C₇H₇; R₂ = H; R₃ = R₄ = CH₃

VI, R₁ = C₇H₇; R₂ = R₃ = R₄ = CH₃

VII, R₁ = H; R₂ = R₃ = R₄ = CH₃

Our thanks are due to Dr. P. R. Jefferies for kindly supplying the natural samples.

Dept. of Chemistry, C. P. BAHL.
University of Delhi, M. R. PARTHASARATHY.
Delhi-7, March 17, 1966. T. R. SESHADRI.

1. Jefferies, P. R. and Payne, T. G., *Aust. J. Chem.*, 1965, **18**, 1441.
2. Hsinnick, C. A. and Jefferies, P. R., *Ibid.*, 1964, **17**, 934.
3. Kobayashi, K., *J. Pharm. Soc., Japan*, 1962, **72**, 1.
4. Rao, P. R., Rao, P. S. and Seshadri, T. R., *Proc. Ind. Acad. Sci.*, 1944, **19 A**, 88.

CHEMICAL INVESTIGATION OF ROOT- BARK AND STEM-BARK OF ALANGIUM LAMARCKII THWAITES

In our previous communications we have reported¹ the isolation of two alkaloids from the fruits of *Alangium lamarckii* which were identified as N-methyl cephaeline and deoxytubulosine.² Although the root-bark and the stem-bark of the above plant have been investigated by other workers,³ we were unable to get any alkaloids reported by them, from the material we had at our disposal. Both the root bark and stem-bark were found by us to contain the same alkaloids as indicated by thin layer chromatogram (R_f values, 0.12, 0.19, 0.31 and 0.4) using a chloroform-methanol (15%) system. From the alkaloid mixture only one alkaloid could be isolated in a pure crystalline condition by chromatography over alumina. The portion eluted with benzene-ether (1:3) crystallised from dilute methanol in colourless needles, m.p. 256-57°.

It gave a positive indole test with Ehrlich reagent, and a positive test characteristic of a tetrahydro- β -carboline system,⁴ namely, the development of a bluish-green colour at the zone of contact between concentrated sulphuric acid containing a few drops of 0.5% sodium nitrite solution and an acetic acid solution of the alkaloid.

The mol. wt. of the alkaloid by mass spectrum was found to be 475. (Found: C, 73.45; H, 7.86; N, 8.4; 'H', 0.4; C-CH₃, 3.6; -OCH₃, 13.6; C₂₉H₃₇N₃O₃ requires C, 73.26; H, 7.79; N, 8.84; 'H', 0.42; C-CH₃, 3.15; 2-OCH₃, 13.02%.)

The ultraviolet absorption spectrum showed $\lambda_{\text{max}}^{\text{alcohol}}$ 281 m μ (log ϵ , 4.16) and a $\lambda_{\text{sh}}^{\text{alcohol}}$ 225 m μ (log ϵ , 4.55), while the infrared spectrum (potassium bromide) showed a sharp band at 2.95 μ (NH-band of an indole or carbazole) as well as a shoulder at 2.7-2.8 μ .

On acetylation with acetic anhydride in methanolic solution, it gave a mono-acetyl derivative which on crystallisation from dilute methanol afforded colourless crystals, m.p. 182-86°. (Found: C, 72.0; H, 7.9; C₃₁H₃₉N₃O₄ requires C, 71.94; H, 7.54%.)

The alkaloid was identified as tubulosine⁵ by a mixed m.p. determination and infrared spectra comparison with an authentic sample generously donated by Prof. V. Deulofeu (Argentina).

We are thankful to Prof. P. V. Bole, Head of the Botany Department, St. Xavier's College, Bombay, for supplying and identifying the plant material. We also thank Shri R. S. Kulkarni, for having carried out the micro-analyses at the Institute.

Dept. of Org. Chem., S. S. SALGAR.
Institute of Science, J. R. MERCHANT.
Bombay-1, February 24, 1966.

1. Salgar, S. S. and Merchant, J. R., *Curr. Sci.*, 1964, **33**, 744.
2. Battersby, A. R., Merchant, J. R., Ruveda, E. A. and Salgar, S. S., *Chemical Communication*, 1965, **14**, 315.
3. Chopra, R. N. and Chowhan, J. S., *Indian J. Med. Res.*, 1934, **21**, 507; Parihar, D. B. and Dutta, S., *Proc. Ind. Acad. Sci.*, 1946, **23 A**, 325; Basu, N. K., Nair, N. S. and Bhattacharya, N. N., *Ind. J. Pharm.*, 1950, **12**, 98; Singh, M. P. and Tiwari, J. D., *Proc. Nat. Acad. Sci.*, 1948, **17 A**, 1; Basu, N. K. and Gode, K. D., *J. Ind. Chem. Soc.*, 1957, **34**, 629; Bhakuni, D. S., Dhar, M. M. and Dhar, M. L., *J. Sci. Ind. Res. (India)*, 1960, **19 B**, 8; Pakrashi, S. C., Parthia, P. and Ghosh-Dastider, *Ind. J. Chem.*, 1964, **2**, 379; Pakrashi, S. C., *Idid.*, 1964, **2**, 468; Siddiqui, S., Ali, M. A. and Ahmad, V. V., *Pakistan J. Sci. Ind. Res.*, 1964, **7**, 144.

4. Kaneko, H., *Chem. Pharm. Bull. (Tokyo)*, 1958, **6**, 318; cf. *C.A.*, 1958, **52**, 20885.
5. Brauchli, P., Deulofeu, V., Budzikiewicz, H. and Dierassi, C., *J. Amer. Chem. Soc.*, 1964, **86**, 1895.

ABSORPTION SPECTRA AND CONFIGURATION OF AMINE COMPLEXES OF COPPER (II) CHROMATE DIHYDRATE

Co-ORDINATION complexes of copper (II) chromate dihydrate with ammonia, ethylenediamine, propylenediamine and diphenylethylenediamine have been prepared. The results of analysis indicate the molecular formulae to be [Cu(amine)₂].CrO₄ and [Cu(amine)₄].CrO₄. The absorption spectra show a single maximum in 600-900 m μ region.

Formation of complex compounds between copper (II) chromate and some aromatic amines has been reported.¹ In the present note, visible absorption measurements, made on a series of complexes prepared with amines, are reported.

The complexes were prepared by shaking a known weight of copper (II) chromate dihydrate with calculated quantities of amines in acetone medium for three hours. The complexes were filtered, washed with acetone and analysed after drying over phosphorus pentoxide. Copper was estimated as copper salicylaldoxime complex, chromate as barium chromate and nitrogen by Kjeldahl method. The amine content was estimated as given by one of the authors.² The visible absorption spectra were recorded on a unicam SP 500 spectrophotometer using nitrobenzene as the solvent first in presence of chromate ion at a concentration of 10⁻² M, and then the chromate ion was removed by the addition of solid barium acetate and measurements were again done on the resulting solution.

The analytical data are given below. The spectral data are recorded in Table I.

1. **Copper (II) Chromate Dihydrate.**—Found: Cu = 29.90%, CrO₄ = 54.04%, CuCrO₄.2H₂O requires Cu = 29.47%, CrO₄ = 53.82%.

2. **Tetramino-copper (II) Chromate.**—Found: Cu = 25.86%, CrO₄ = 47.05%, N = 22.02%, base = 27.50%; [Cu(NH₃)₄].CrO requires Cu = 25.66%, CrO₄ = 46.86%, N = 22.50%, base = 27.47%.

3. **Bis-ethylenediamino-copper (II) Chromate.**—Found: Cu = 21.40%, CrO₄ = 39.05%, N = 19.00%, base = 40.50%; [Cu(en)₂].CrO₄ requires Cu = 21.19%, CrO₄ = 38.70%, N = 18.69%, base = 40.06%.

TABLE I
Visible absorption measurements

Name (Compound)	Absorption maxima in m μ		
	In presence of CrO ₄ ⁻²	After removal of CrO ₄ ⁻²	ϵ
1. Copper (II) chromate dihydrate	775	770	120
2. Tetramino-copper (II) chromate	642	649	145
3. Bis-ethylenediamino copper (II) chromate	650	651	140
4. Bis-propylenediamino-copper (II) chromate	645	645	141
5. Bis-diphenylethylene di-amino-copper (II) chromate	650	648	140

4. Bis-propylenediamino-copper (II) Chromate.—Found: Cu = 18.07%, CrO₄ = 32.10%, N = 15.45%, base = 49.80%; [Cu(pn)₂]CrO₄ requires Cu = 17.88%, CrO₄ = 32.66%, N = 15.75%, base = 49.53%.

5. Bis-diphenylethylenediamino-copper (II) Chromate.—Found: Cu = 10.28%, CrO₄ = 19.85%, N = 9.76%, base = 70.99%; [Cu(dip.en)₂]CrO₄ requires Cu = 10.44%, CrO₄ = 19.23%, N = 9.30%, base = 70.32%.

The results of analysis indicate molecular formulæ to be CuCrO₄.2 amine and CuCrO₄.4 amine. The complexes are all green in colour and dissolve in nitrobenzene and formamide. The measurements of molar conductance in nitrobenzene (10⁻³ M) give a value in the vicinity of 20 mhos, showing that the complexes dissociate into two ions.³ Further if to a formamide solution of complexes, barium acetate is added, it results in the precipitation of yellow barium chromate, and the resulting solution assumes a deep ink blue colour characteristic of copper-amine complexes.⁴ These results indicate that the chromate ion is not co-ordinated to the metal and is present in outer sphere. The formulæ of the complexes are thus written as [Cu(amine)₂]CrO₄ and [Cu(amine)₄]CrO₄.

The complexes show a single absorption maximum in the range of 600–900 m μ region, in presence of chromate ion as well as after its removal. This particular band (maxima) is to be associated with 2E_g → 2T_{2g} transition.

The position of this band depends on the intensity of ligand field around the metal. Thus for tetra-aquo-copper (II) ion the band is observed at 800 m μ and for tetramino-copper (II) ion at 600 m μ . This hypsochromic shift

is due to the stronger amine field which causes the band to move from far red to the middle of the red region of the spectrum.

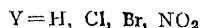
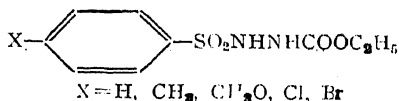
Dept. of Chemistry, (Miss) PADMAJA SHUKLA.
Lucknow University, GOPAL NARAIN.
Lucknow, India. December 17, 1965.

1. Genchev, M. L. and Pozharliev, I. V., *Compt. rend. Acad. Bulgare Sci.*, 1956, 9 (4), 33.
2. Gopal Narain, *Cand. J. Chemistry* (in press).
3. Nyholm, R. S., *J. Chem. Soc.*, 1957, p. 1714.
4. Sidgwick, N. V., *Chemical Elements and Their Compounds*, 1, 156.

SYNTHESIS OF SULPHONYL URETHANES

SEDATIVE or hypnotic activity is manifested in numerous organic compounds amongst which urethanes comprise an important class. Urethanes retard the growth of specific tumors and also bring about the destructive action on leukocytes.¹ The activity of 6-azauracil on tumors is enhanced by urethanes.² Several analogues of urethane, Aleudrine, Aponal, Hedonal and Volantal have been used satisfactorily as sedatives.³ Phenyl sulphonyl urethanes have been found to possess significant sedative and antituberculous effects.⁴

Aryl and thienyl sulphonyl urethanes have been reported in this communication. These were prepared with a view to study their physiological activities.



EXPERIMENTAL

General Method of Preparing Sulphonyl Urethanes.—A mixture of sulphonyl hydrazine (0.1 mole), ethylchloroformate (0.11 mole) and benzene (200 ml.) with a drop of pyridine was refluxed on a water-bath for four hours. On cooling and distilling of the solvent, the solid separated. This was washed with dilute hydrochloric acid and finally with water. It was crystallised from benzene. Average yield 40–45%.

Sulphonyl urethanes prepared by this method are described in Table I.

TABLE I
R-SO₂NHNHCOOC₂H₅

R =	M.P. °C.	Mol. formula	Analysis			
			% N		% S	
			Found	Calcd.	Found	Calcd.
C ₆ H ₅	.. 85	C ₉ H ₁₂ N ₂ O ₄ S	11.4	11.5	13.0	13.1
<i>p</i> -CH ₃ ·C ₆ H ₄	.. 125	C ₁₀ H ₁₄ N ₂ O ₄ S	10.7	10.9	12.2	12.4
<i>p</i> -CH ₃ O·C ₆ H ₄	.. 124	C ₁₀ H ₁₄ N ₂ O ₅ S	10.1	10.2	11.6	11.7
<i>p</i> -ClC ₆ H ₄	.. 82	C ₉ H ₁₁ ClN ₂ O ₄ S	10.0	10.1	11.4	11.5
<i>p</i> -BrC ₆ H ₄	.. 93	C ₉ H ₁₁ BrN ₂ O ₄ S	8.5	8.7	9.7	9.9
2-thienyl	.. 121*	C ₇ H ₁₀ N ₂ O ₄ S ₂	11.0	11.2	25.3	25.6
2-Chloro-5-thienyl	.. 124	C ₇ H ₉ ClN ₂ O ₄ S ₂	9.7	9.8	22.3	22.5
2-Bromo-5-thienyl	.. 125	C ₇ H ₉ BrN ₂ O ₄ S ₂	8.2	8.5	19.3	19.5
2-Nitro-4-thienyl	.. 130	C ₇ H ₉ N ₃ O ₆ S ₂	14.0	14.2	21.4	21.7

* Mixed melting point with the parent compound was found to depress considerably.

Department of Chemistry, A. A. MUNSHI.
St. Xavier's College, J. P. TRIVEDI.
Ahmedabad-9, February 17, 1966.

TABLE I
Amino-acid composition of *Dermatocarpon moulinsii*

1. Bailey and Christian, *J. Am. Pharm. Assoc. (Science Edn.)*, 1952, **41**, 517.
2. Hitchings and Bieber, U.S.Pat. 3019164/1957; *C.A.*, 1962, **56**, 8860.
3. Rice, *J. Am. Pharm. Assoc.*, 1944, **33**, 1944.
4. Lanyi and Szabo, *C.A.*, 1961, **55**, 17560.

AMINO-ACIDS OF *DERMATOCARPON MOULINSII*

Dermatocarpon moulinsii (Mont.) Zahlbr. (*Dermatocarpaceae*) is a (grey to brown) foliose lichen recorded in the lichen flora of India¹ and distributed widely in the Himalayan ranges. Its thick thallus is reported² to be useful as cork substitute for lining insect collection boxes. In continuation of our earlier work³⁻⁶ on the amino-acids of Indian lichens we have studied samples of the lichen, growing on rocks in Nandaprayag (alt. 3,000 ft.) and Charanapaduka (alt. 12,000 ft.) areas of the Western Himalayas, for its amino-acids and our results are given in brief (Table I).

The lichen has been found to contain about 20% of crude protein (Kjeldahl estimation) and 12% of carbohydrate (in terms of glucose obtained after acid hydrolysis). The lichen gave an abnormally high figure of about 20% for total ash, out of which three-fourths was acid-insoluble. On further analysis of the mineral constituents, it has been found that the lichen was rich in iron (about 1%), calcium (0.5%) and phosphorus (40 mgm.%).

It is interesting to note that of all the Indian lichens so far studied³⁻⁶ for their amino-acid patterns, *D. moulinsii* is particularly rich in

S. No.	Amino-acids	Free*	Combined†
1	Alanine	.. 3+	2+
2	Arginine	.. +	+
3	Aspartic acid	.. +	+
4	Glutamic acid	.. 2+	2+
5	Glycine	.. 2+	2+
6	Histidine	.. ..	..
7	Isoleucine‡	.. 4+	2+
8	Leucine‡	.. 4+	3+
9	Lysine‡	.. +	+
10	Methionine‡	.. 4+	3+
11	Phenyl alanine‡	.. 2+	2+
12	Proline	.. 2+	+
13	Serine	.. +	2+
14	Threonine‡	.. 2+	2+
15	Tryptophan‡	.. ..	+
16	Tyrosine	.. +	2+
17	Valine‡	.. +	+
18	Unidentified	.. ..	+

* Each + indicates about 3 mg.% of the dry lichen.

† Each + indicates about 200 mg.% of the dry lichen.

‡ Indispensable amino-acids.

free amino-acids and practically all the common protein amino-acids occurring in higher plants are found in this. This feature in its amino-acid pattern, when compared with the limited number of amino-acids in other Indian lichens, appears to indicate that *Dermatocarpon* species should be considered to occupy a special place in the (biochemical) evolution of lichens in the plant kingdom. This is also supported by the fact⁷ that *D. moulinsii* does not biosynthesise any of the so-called characteristic lichen acids and contains only ergosterol and D-volemitol as its chemical components. Probably the higher proportion of mineral constituents may be attributed to a close association of the lichen with its habitat (rocks). It may also be added

that *D. miniatum*^s contains only D-volemitol and no depside or depsidone.

In view of the high protein content and the interesting amino-acid composition (eight essential amino-acids present) together with ergosterol and inorganic constituents of iron and calcium, this lichen appears to have good food value. The absence of lichen acids is an added advantage in this respect.

We thank Prof. T. R. Seshadri, F.R.S., for his kind interest in this work and the lichen samples, and Principal Dr. D. J. Reddy for encouragement.

Dept. of Chemistry, S. RAMAKRISHNAN.
Jawaharlal Institute S. SANKARA SUBRAMANIAN.
of Postgraduate Medical
Education and Research,
Pondicherry-6, January 5, 1966.

1. Biswas, K., *J. Royal Asiatic Soc. Beng.*, 1947, 13, 80.
2. *The Wealth of India. Raw Materials*, Council of Scientific and Industrial Research. New Delhi, 1962, 6, 34.
3. Ramakrishnan, S. and Subramanian, S. S., *Indian J. Chem.*, 1964, 2, 467.
4. Subramanian, S. S. and Ramakrishnan, S., *Curr. Sci.*, 1964, 33, 522.
5. Ramakrishnan, S. and Subramanian, S. S., *Ibid.*, 1965, 34, 345.
6. — and —, *Ibid.*, 1966, 35, 124.
7. Seshadri, T. R., Private communication.
8. Asahina, Y. and Kagitani, M., *Ber.*, 1934, 67, 804.

A NOTE ON THE OCCURRENCE OF TRACHYTE AT BAGH IN DHAR DISTRICT OF MADHYA PRADESH

IN the north-eastern portion of Bagh, in Dhar District of Madhya Pradesh, an association of trachyte with the Deccan Trap basalt offers an interesting problem in differentiation of the traps. Trachytes were reported by P. N. Bose (1884) and W. T. Blanford (1869) from Kawant and Matapenai Hills respectively in the Narmada valley in Gujarat State.

The trachyte in the Dhar area appears to be a flow which seems to continue from the Kadiwal forest station (N. 22° 20', E. 74° 49') to Deodha-Undli (N. 22° 20', E. 74° 51') and farther south-east to Agar and Mahakal. At Kadiwal it has a greater thickness than at Deodha-Undli.

It shows a pronounced trachytic flow texture (Fig. 1), the feldspars being oriented in the direction of the flow in more or less parallel alignment. They form 45 to 47% of the rock. The pyroxene phenocrysts are smaller in dimension than the plagioclase. The ground-mass consists essentially of lath-shaped micro-

lites. Aggregates of feldspars and pyroxenes at places indicate 'glomeroporphyritic texture'. The phenocrysts of plagioclase are larger than those of pyroxene.

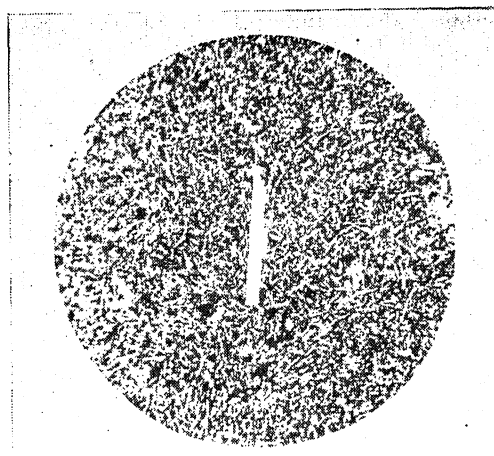


FIG. 1. Trachytic flow texture around the Phenocryst of plagioclase Feldspar. Under plane polarised light (17 × 3).

The phenocrysts are twinned as well as zoned, with rare cruciform or interpenetration twins. The 2V is 86°, negative, thus giving a composition of Ab₃₀ An₇₀ (oligoclase). The microlites show straight extinction. In one section zoning with 'Synneuses structure' (Vance, 1962) was observed, described from the Deccan traps of Bhopal by Chatterjee (1964). Delicate oscillatory zoning is also seen.

Pyroxene is present both as phenocrysts as well as in the ground mass. It is not pleochroic. The rock is rich in iron ore which constitutes 21.73% by volume and occurs as elongated bars and irregular patches. Glass is the only other primary mineral present.

The author is indebted to Dr. S. C. Chatterjee, under whose guidance the work has been done.

Dept. of Geology, R. R. NANDGAONKAR.
Vikram University,
Ujjain, December 9, 1965.

1. Bose, P. N. "Geology of Lower Narbada Valley," *Mem. Geol. Surv. of India*, 1884, 21, 8.
2. Blanford, W. T., "On the Geology of the Taptee and Lower Narbada Valleys and some adjoining districts," *Ibid.*, 1869, 6, Pt. 3.
3. Chatterjee, A. C., *Curr. Sci.*, 1964, 33, 142.
4. Vance, J. A., "Zoning in Igneous Plagioclase Normal and Oscillatory zoning," *Am. Jour. Soc.*, 1962, 260.

A NOTE ON THE TUNDAPATHAR LIMESTONE, MORNI HILLS, AMBALA DISTRICT, PUNJAB

SOME patches of Palaeozoic (?) rocks occur along the Main Boundary Fault and extend from Malla (30° 46' 15" : 76° 59' 30") to Sherla (30° 40' : 77° 07') in Ambala District, Punjab. These are recognised as Tundapathar Series after Tundapathar (30° 45' : 77° 01') where the limestone crag is exposed. Most of the area has remained unexplored, and the detailed stratigraphic position and structure of the rocks has yet to be delineated. However, the senior author¹ investigated this area with a view to ascertain the reserves and quality of the limestone deposits.

The best section in the area is exposed near Tundapathar where the following sequence is met with :

	Nahans	Thrust (Main Boundary Fault)
Tundapathar Series (Unfossiliferous)	Carbonaceous quartzite Carbonaceous shales Light grey limestone Carbonaceous shales Light grey limestone Greenish shales with quartzites	18' 150' 20'-45' 125' 25'-80' 55'
(Fossiliferous)	Subathus	

The Tundapathar Series occurs as small islands. The thickness of the limestone is not constant in the area, its outcrops pinch out at places and the associated shales become wider in extent. Drags have been formed near the contact of limestone and shales. Their study reveals that the area was subjected to two types of movements, of which the first, the major movement was responsible for bringing the Tundapathar Series over the Nahans, and this may be a part of Krol thrust (?). The compressional forces as the drags show acted in NE-SW direction, and probably originated in the north. The second movement caused wrench faulting in the Series, and also puckering in the shales, and acted in a N-S direction.

The most interesting point is that the limestone was not deposited *in situ* but was brought to its present position by tectonic movements. This is indicated by the associated shales which are highly polished and have a smooth, slickensided surface. The pinching and swelling out of the limestone suggests plastic flow of the limestone—a process that may have been active during the tectonic movements, which affected the bedding and other sedimentary structures.

No fossils have so far been recorded from this Series and its age is therefore uncertain. The greater degree of metamorphism and unfossiliferous nature of the sediments differentiate them from the Subathus (Eocene). Also, it may safely be concluded that the Series is older than Eocene. Auden (1948)² considers that "this may represent a pre-Tertiary wedge between the Eocene younger Tertiaries and Krol rocks". However, there is no definite evidence to prove its pre-Tertiary age. Raina (1964)³ has suggested the occurrence of this limestone as *klippe*. He holds that these are either remnants of an earlier extensive *nappe* or detached glided masses from the Krol and Shali nappes. The tectonic movements may not have obliterated the fossils completely and further investigations should prove fruitful in settling the issue.

Geology Department,

M. R. SAHNI.

Panjab University,

RAMESH KUMAR.

Chandigarh-3, January 15, 1966.

1. Sahni, M. R. and Iyengar, B. R. C., *Report G.S.I., Field season, 1948-49.*
2. Auden, J. B., *Indian Minerals*, 1948, 2 (2).
3. Raina, B. N., *J.G.C. Report*, 22nd Session, India, 1964, Vol. of Abstracts, p. 180.

MUCOPOLYSACCHARIDES IN THE CAUDAL GLAND OF CRYPTOZONA (XESTINA) SEMIRUGATA (BECK)

BARR² observed the caudal gland of *Arion ater* was rich in mucus. A similar observation in *Cryptozona (aetina) semirugata* led to this work. The present investigation deals with mucopolysaccharides.

Animals were dissected alive. The glands were fixed in absolute alcohol for four hours at room temperature. Blocks were prepared by usual method. The techniques used were the PAS,⁵ AB,⁴ AB-PAS,⁴ toluidine blue (·003%), azure A at pH 1·5 and pH 4·5⁷ and aluminium sulphate methylene blue.³ These tests were followed by routine control methods of pyridine extraction,¹ methylation, demethylation⁷ and acid hydrolysis.⁶

The PAS staining for mucus glands was weak and pyridine extraction had no effect. AB showed an intense staining in the mucus cells (Fig. 1). Methylation at 37° C. for four hours showed no change, but at 58° C. for four hours, a considerable loss was noticed, while demethylation instead of restoring the staining abolished it. The gland cells were metachromatic to weak toluidine blue and azure A, while some cells were orthochromatic to both dyes. Acid hydrolysis at 60° C. for four hours had no effect on

AB staining. The cells stained with aluminium sulphate methylene blue.

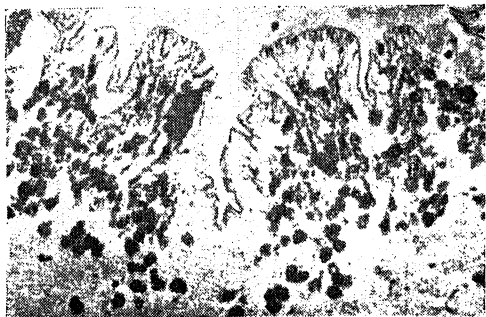


FIG. 1. A portion of caudal gland showing mucus-secreting cells. AB staining, $\times 200$.

From the findings one may conclude that the carbohydrates and mucopolysaccharides are present in the gland cells. The mucopolysaccharides are of two types, one resistant to methylation and non-resistant to demethylation, while the other is totally lost during methylation. The former may be due to sulphated mucopolysaccharides or sialic acid while the other due to some chemically unknown material. The results with toluidine blue, azure A at pH 1.5, and aluminium sulphate methylene blue support the presence of sulphated mucopolysaccharides.

Thanks are due to Prof. Nadkarni for facilities and Prof. Mehta and Shri Mustafa for help.

Zoology Department,
N. Wadia College,
Poona-1, November, 1965.

P. V. JOSHI.

1. Baker, J. R., *Quart. J. Micr. Sci.*, 1946, **87**, 441.
2. Barr, R. A., *Ibid.*, 1927, **71**, 503.
3. Heath, I. D., *Nature*, 1961, **191**, 1370.
4. Mowry, R. W., *J. Histochem. Cytochem.*, 1956, **4**, 407.
5. Pearse, A. G. E., *Histochemistry, Theoretical and Applied*, 2nd ed., J. and A. Churchill Ltd., London, 1960, p. 242.
6. Quintarelli, G., *Ann. N.Y. Acad. Sci.*, 1963, **106**, 339.
7. Spicer, S. S., *J. Histochem. Cytochem.*, 1960, **8**, 18.

A NEW SPECIES OF *PLEIOCHAETA* ON *CASSIA SUMATRANA* ROXB.

IN the course of gathering mycoflora prevailing in and around Bangalore, an interesting leaf-spot disease of *Cassia sumatrana* was observed. *C. sumatrana* (*C. siamea* Lamk.), a native of Sumatra, is grown as an avenue tree. It is utilized as green and conserved fodder and also as green manure and soil cover.

The characteristics of the fungus suggest that it should be assigned to the genus *Pleiochaeta* (Sacc.) Hughes (Hughes, 1951). So far only two species have been described. *P. albizziae* (Petch) Hughes on *Albizzia moluccana* Miq. (Hughes, 1951) on subfamily Mimosoideae and *P. setosa* (Kirchn.) Hughes on *Crotalaria*, *Cytissus*, *Laburnum*, *Lupinus* and *Phaseolus* (Pag, 1964) belonging to subfamily Papilionoideae. In *P. albizziae* conidia are hyaline with forked setae. In *P. setosa* the conidia have dark median cells and hyaline end-cells, the setae being branched. Our fungus differs from these two in the dimensions of the conidia and setae and also the completely coloured conidia. So far there is no record of a *Pleiochaeta* on *Cassia sumatrana*. In view of these distinct features and also the fact that this is the first report on a new host subfamily Caesalpinoideae, we propose the name *Pleiochaeta cassiae* to accommodate this fungus.

Pleiochaeta cassiae GOVINDU, SHETTY & LUCY
SP. NOV.

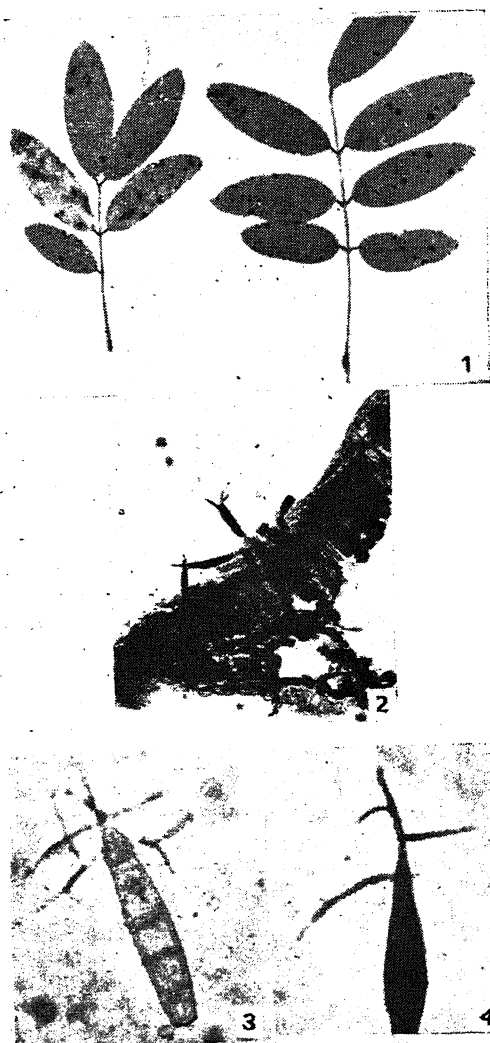
Infection spots minute, dark brown enlarge gradually, slightly sinking centrally, become light brown with 1-2 pale yellowish concentric zones, 1-5 mm. in diameter, coalesce and form irregular patches, surrounding areas become chlorotic and such leaflets prematurely shed. Young hyphae thin-walled, septa far apart, older hyphae dark brown, closely septate, 8-14 μ in diameter. Conidiophores simple, short, aseptate, protuberant, sub-geniculate, pale olivaceous brown, 16-30.5 \times 9-12 μ . Conidia fusiform, slightly curved, 2-5 septate, slightly bulging at the septa, dark brown, 33.45-85.14 \times 9.12-15.2 μ median cells thick-walled, dark brown, terminal cells thin-walled, narrower, light brown of which basal cell truncate, apical cell sub-hyaline, sub-conical with 2-3 (rarely 4) long slender, hyaline, irregularly branched, tapering basally septate setae, 30.4-51.7 \times 3 μ .

Hab.: On living leaves of *Cassia sumatrana* Roxb., at Hebbal (Bangalore), July 20, 1964, Leg. K. Shivappa Shetty, Herb. No. MYSP. 741 (Type) (Figs. 1-4).

Pleiochaeta cassiae GOVINDU, SHETTY & LUCY
SP. NOV.

Infectionis maculae minutae, fusce brunneae, gradatim dilatantes, leviter in medio sidentes, tardius pallide brunneae, cum 1-2 leviter luteis concentricis regionibus, 1-5 mm. diam., in decolorationes irregulares coalescentes; partes circumsedentes chloroticae; folioli infecti praemature decedentes. Hyphae immaturae parietibus tenuibus, septis remotis; maturae vero arcte septatae, 8-14 μ diam. Conidiophora simplicia,

brevia, aseptata, protrudentia, sub-geniculata, pallide olivaceo-brunnea, $16-30.5 \times 9.12 \mu$ Conidia fusiformia, leviter curvata, 2-5 septis ornata, paulo prope septa tumescentia, fusce brunnea, $33.45-85.14 \times 9.12-15.2 \mu$. Cellulæ in medio parietibus crassis, fusce brunneæ; terminales vero parietibus tenuibus, angustatæ, pallide brunneæ; harum basalis truncata, apicalis vero sub-hyalina, sub-conica, 2-3 (raro 4) longis, tenuibus hyalinis, irregulariter ramosis, attenuatis, basi septatis setis $30.4-51.7 \times 3 \mu$ præædita.



FIGS. 1-4

Hab.: In foliis viventibus *Cassia sumatrane* Roxb., ad Hebbal (Bangalore) mense Julio 1964, legit K. Shivappa Shetty. Typus in Herb. MYSP sub-numero 741 positus.

The authors are grateful to Dr. C. J. Saldanha for kindly giving us the Latin diagnosis of the new species and to Dr. H. C. Govindu, Plant Pathologist, for kind encouragement and help in preparing this paper.

Plant Path. Section, K. SHIVAPPA SHETTY,
Agric. Research Inst., K. A. LUCY CHANNAMMA,
Hebbal, Bangalore-24,
December 4, 1964.

1. Hughes, S. J., "Studies on micro fungi. III. *Mastigosporium*, *Camosporium* and *Ceratophorum*," *Mycol. pap.* (Commonwealth Mycol. Inst.), 1951, p. 36.
2. Pag, H. "Pleiochaeta setosa als Krankheitserrger an *Cytisus* \times *racemosus*," *Nachr. Bl. dt. Pfl. int. dienst. Stuttgart*, 1964, 16 (7), 107.

PHENOLIC ACID PATTERN AND ITS BEARING ON THE SYSTEMATIC POSITION OF ARISTOLOCHACEAE

THE systematic position of Aristolochiaceae is much disputed owing to its peculiar morphological characteristics. Hutchinson¹ regarded it as a primitive family and Aristolochiales was accordingly placed by him along with Ranales and Berberidales. Embryological grounds suggest² that Aristolochiaceae is related to Anonaceae. On the other hand, in Bessey's classification³ Aristolochiaceae finds a place in Myrtales thereby holding a more advanced position. The present investigation concerns a comparison of the phenolic acid composition of *Aristolochia* with that of members of Anonaceae on the one hand and with Myrtaceae and Combretaceae of the order Myrtales on the other, with a view to examine if comparative chemistry could offer a solution to the above dispute.

Leaves of *Aristolochia bracteata*, Retz.; *Anona squamosa*, Linn.; *Polyalthia longifolia*, Hook. F. and Thoms; *Syzygium jambolanum*, DC. W. and A.; *Psidium guajava*, Linn.; *Quisqualis indica*, Linn., were collected from the plants just before analysis. The extraction of phenolic acids, subsequent paper chromatography and the identification of constituents were as per the technique described previously.^{4,5}

The results are shown in Table I.

A striking resemblance was observed between the phenolic acid composition of *Anona* and *Polyalthia* both belonging to Anonaceae and *Aristolochia* of Aristolochiaceae. *Syzygium* and *Psidium* of Myrtaceae as well as *Quisqualis* of Combretaceae had common pattern amongst themselves being characterised by the absence of caffeic acid and the occurrence of ellagic acid. The reverse pattern is true in the case of

TABLE I

Phenolic acid composition of leaves of members of Anonaceae, Aristolochiaceae, Myrtaceae, and Combretaceae

Acid	Anona	Polyalthia	Aristolochia	Syzygium	Psidium	Unisqualia
Caffeic acid	..	+	+	+	-	-
Protocatechuic acid	..	+	+	+	+	+
Ellagic acid	..	-	-	-	+	+
Gentisic acid	..	+	+	+	+	-
Chlorogenic acid	..	+	+	+	-	-
p-Coumaric acid	..	+	+	+	+	+
p-Hydroxybenzoic acid	..	+	+	+	+	+
Vanillic acid	..	+	+	-	+	-
Ferulic acid	..	trace	+	+	trace	+
Sinapic acid	..	-	+	-	-	+
o-Coumaric acid	..	+	+	+	+	+

Anonaceae where caffeic acid was absent. The same holds true for Aristolochiaceae. In addition, chlorogenic acid was uniformly absent in members of myrtales while it was present in both Anonaceae and Aristolochiaceae. The finding of absence of caffeic acid and the occurrence of ellagic acid in Myrtales agrees with that reported by Bate-Smith.⁶ While there were minor differences within the members of a family or between families in the order, a remarkable uniformity within the taxa was, however, apparent inasmuch as the distribution of the fundamental constituents are concerned.

Based on the present investigation it is concluded that the evidence from comparative phenolic acid composition is in favour of placing Aristolochiaceae along with Anonaceae rather than with the more advanced families like Myrtaceae.

The authors thank Prof. I. M. Rao for encouragement.

Department of Botany,
S.V. University,
Tirupati (A.P.),
December 23, 1965.

V. S. R. DAS.
K. N. RAO.
J. V. S. RAO.

MALE STERILE BARLEY

AVAILABLE information on male sterility and hybrid vigour in barley is mainly confined to Californian conditions.¹⁻⁵ Similar studies are, therefore, needed to assess the possibilities of the production of hybrid barley in India for increasing the yield. The present communication deals with the studies carried on ten male sterile lines isolated at B.R. College Research Station at Bichpuri, Agra (India). Nine out of these ten male sterile lines have been isolated from a sample of composite bulk of barley obtained from U.S.D.A., while the remaining one is from an Indian variety N.P. 17. All these appear to be of genetic type and have been named as Male Sterile Bichpuri Nos. 1 to 10 (abbreviated as Ms.B.₁, Ms.B.₂,, Ms.B.₁₀) and are classified into five types under two main groups as follows :

(A) With open spikelets :

Type No. 1. Six-rowed hooded type (Ms.B.₁ and Ms.B.₂).

Type No. 2. Two-rowed hooded type (Ms.B.₃).

Type No. 3. Six-rowed awned type (Ms.B.₄ and Ms.B.₅).

Type No. 4. Two-rowed awned type (Ms.B.₆).

(B) With closed spikelets :

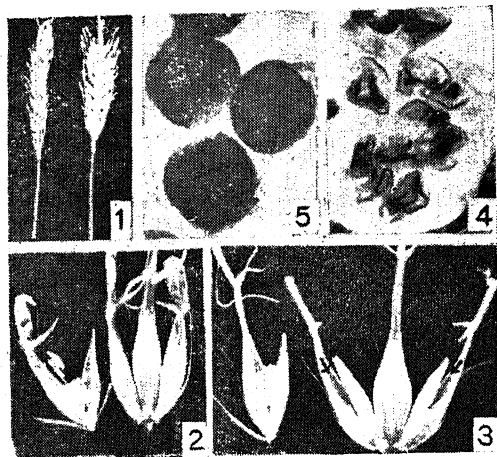
Type No. 5. Six-rowed awned type (Ms.B.₇₋₁₀).

Perusal of the above shows that the first four male sterile types are characterised by open nature of spikelets, which is due to the presence of a space between lemma and palea (Figs. 1 and 2). This gives a broader appearance to the spikelets of the male sterile plants than those of the male fertile plants. The loose character helps in rouging out the male fertile plants from the lines easily. This is further facilitated in Ms.B.₂ and Ms.B.₄ by the absence of the pigmentation of the veins of the lemma of the male fertile plants. The fertile counterparts of all except Ms.B.₁ and Ms.B.₄, where the spikelets are of the open type and the male sterile lines Ms.B. Nos. 7, 8, 9 and 10, possess closed type spikelets (Fig. 3).

The size of the anthers in all the sterile types is found to be smaller than those of the fertile lines. This difference becomes characteristically prominent immediately after uninucleate pollen grain stage. The pollen grains of the male sterile plants (Fig. 4) in general are empty, devoid of cytoplasm with shrunken walls. They mostly remain clumped together in groups of various numbers. Pollen grains from the fertile

1. Hutchinson, J., *The Families of Flowering Plants*, Clarendon Press, Oxford, 1959, 1, 116.
2. Johri, B. M. and Bhatnagar, S. P., *Phytomorphology*, 1955, 5, 123.
3. Lawrence, G. H. M., *Taxonomy of Vascular Plants*, MacMillan Company, New York, 1951, p. 126.
4. Das, V. S. R. and Rao, J. V. S., *Curr. Sci.*, 1964, 33, 471.
5. —, Rao, K. N. and Rao, J. V. S., *Ibid.*, 1966, 35, 160.
6. Bate-Smith, E. C., *J. Linn. Soc. (Bot.)*, 1962, 58, 95.

plants (Fig. 5) on the contrary are turgid, full of cytoplasm and take deep stain. They are released at the trinucleate stage.



FIGS. 1-5. Fig. 1. A male fertile (left) and a male sterile spike (right). Fig. 2. Male fertile spikelet (left) slightly opened to expose the anthers for view and on the right are the three spikelets at a node in natural arrangement. Fig. 3. Male sterile: Same as in Fig. 2. Mark the natural opening in the spikelets. Figs. 4-5. Pollen grains from male sterile and male fertile plants respectively, $\times 400$.

The male sterile plants are perfectly female fertile, as is evident by seed-set up to 95% on hand-pollination. Cross-pollination to the extent of 70% has been recorded in Ms.B.₁ and Ms.B.₂. This could be further increased up to 75% by clipping off the upper part of the spikelets. A high percentage of cross-pollination, as this in the male sterile lines of a highly self-pollinating crop like barley, makes them suitable for use in the large-scale production of hybrid seeds.

Department of Botany,
B.R. College, Agra,
December 2, 1965.

S. P. SINGH.
C. L. KAUL.

1. Suneson, C. A., *Jour. of Heredity*, 1940, **31**, 213.
2. — and Riddle, O. C., *J. Am. Soc. Agron.*, 1944, **36**, 57.
3. Grafius, J. E., *Agron. J.*, 1959, **51**, 551.
4. Wiebe, G. A., *Ibid.*, 1960, **52**, 181.
5. Suneson, C. A., *Crop Sci.*, 1962, **2**, 410.

CHEMICAL CONSTITUENTS OF *GARCINIA LIVINGSTONEI* T. ANDERS.

The *Garcinia* species (Guttiferæ) would appear to be of interest in view of the anti-bacterial activity of the compound, morellin, $C_{30}H_{34}O_6$, isolated from *G. morella* Desr. In view of this fact it was considered desirable to investigate the chemical constituents of *G. livingstonei*

T. Anders. about which no reference is available in literature.

The defatted (petrol ether) alcoholic concentrates of the extracts of the seeds were successively triturated with benzene and ethyl acetate. The combined extracts were concentrated and kept in the cold when a yellow microcrystalline deposit was obtained. It was purified through fractionation with organic solvents and the final product on repeated crystallisations from alcohol yielded (0.1%) colourless needles, m.p. 263–64° C., $C_{15}H_{12}O_6$. The compound was soluble in dilute alkalis, gave a green colouration with ferric chloride and a positive test for flavanoids with magnesium and hydrochloric acid. It yielded a tetraacetyl derivative, m.p. 137° C., $C_{23}H_{20}O_{10}$, with acetic anhydride and fused sodium acetate and a trimethyl derivative, m.p. 136° C., $C_{18}H_{18}O_6$, with diazomethane. The six oxygen atoms in the original compound are thus accounted for as four hydroxyl functions and two in the benzopyrone ring.

The substance on fusion with caustic potash and working up the reaction mixture in the usual manner gave protocatechuic acid and phloroglucinol, which would indicate the four hydroxyl functions to be present in the 5:7- and 3':4'-positions. A reference to literature showed the possibility of the compound to be eriodictyol or 5:7:3':4'-tetrahydroxyl flavanone and the identity was finally established through a comparison of the melting points and mixed melting points of the substance and its derivative with those of eriodictyol and its corresponding derivatives and superimposable IR spectra.

The authors are thankful to Shri J. G. Srivastava for the supply of the plant material. National Botanic Gardens, Lucknow (U.P.),
S. N. SRIVASTAVA.
V. N. SHARMA.
December 16, 1965.

1. Rao R. R. and Natarajan, *Curr. Sci.*, 1950, **19**, 59.
2. Rao, B. S., *Jour. Chem. Soc.*, 1937, p. 853.

THE CYTOLOGY OF MYLLOCERUS *VIRIDENS* F. (COLEOPTERA: CIRCULIONIDAE)

The weevils belonging to the family Circulionidae comprise more than 35,000 species of which the chromosomal cytology of about 64 species alone have been recorded by Stevens,¹ Seiler,² Mikulska,³ Smith,⁴ Suomalainen,⁵ Takenochi.⁶ Out of these about 43 species belong to the subfamily Otiorrhynchinae. The latter exhibits

both diploid bisexual XO, XY or (XY)₂: XX and polyploid parthenogenetic mechanisms of sex determination. The cytology of Indian species is, however, unknown.

The species *Myloccerus viridens* F. under the subfamily Otiorrhynchinae was collected from *Solanum melangena* at Pondicherry in the month of April 1960. The testes were dissected out in the living condition and fixed in Carnoy's fluid. Sections were cut 21 12-15 micra and stained in crystal violet. Camera lucida drawings were made using a Leitz microscope with an apochromatic objective of 1.3 NA and a 10 × ocular. The magnification is indicated by scale.

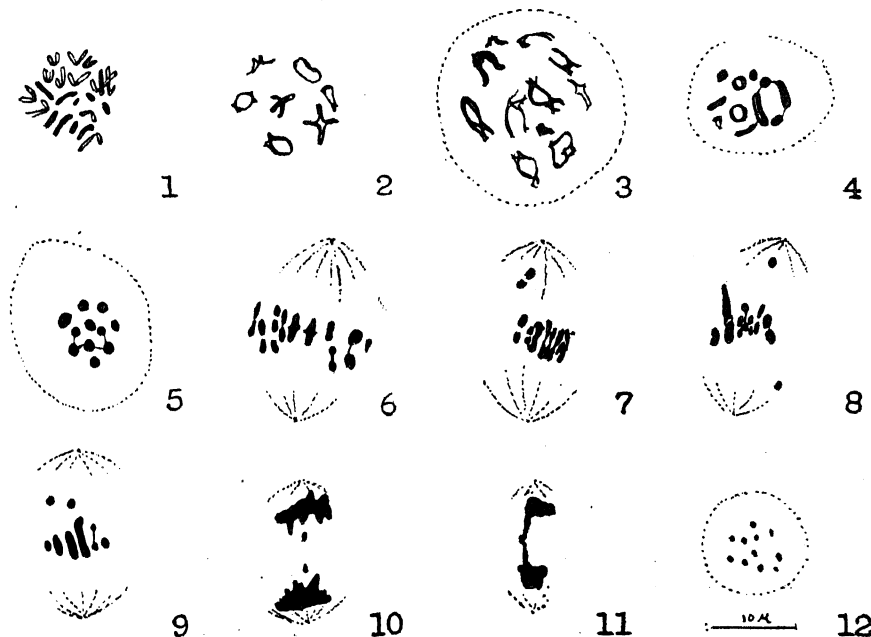
The early spermatogonial nuclei are diffused and faintly stained except for the two peripherally situated heteropycnotic sex chromosomes which differ in size and are suggestive of the X and Y chromosomes.

The diploid chromosome number at spermatogonial metaphase (Fig. 1) is 22 as in almost all bisexual weevils (Smith⁷). No convenient size classes could be made as the difference in sizes of the chromosomes seems gradual. There

are 7 V, 6 J, 5 rods and the rest are dot-shaped chromosomes representing median, submedian or subterminal centromeric positions.

The diplotene and diakinesis (Figs. 2-4) evince 11 bivalents with cross, open cross, rod and at least one conspicuous ring configuration. The XY sex bivalent which forms the 'parachute' is not always clear even in squash preparation probably due to their minuteness and malorientation and may often appear as an eccentrically placed dot due to excessive stain. At diakinesis tenuous chromatin connections in between the bivalents are common.

During metaphase I polar view (Fig. 5) the 11 bivalents are round or oval-shaped often with tenuous chromatin connections and are arranged more or less in a regular concentric garniture. In side view (Figs. 6-9) often there is a clear indication of the advance movement of a bivalent; at least one element and in rare cases there may be also two moving in the opposite or in the same polarities. They probably refer to X and Y. At this stage the bivalents are mostly rods, each with a single terminalized or rarely with an interstitial



FIGS. 1-12. Fig. 1. Spermatogonial metaphase. Fig. 2. Varied configurations of bivalents at diplotene taken from different cells. Fig. 3. Diplotene. Fig. 4. Diakinesis. Fig. 5. First division metaphase (polar view). Fig. 6. First division metaphase (side view). Fig. 7. First division metaphase (side view) showing the advance movement of a bivalent. Fig. 8. First division metaphase (side view) showing two elements moving to opposite poles. Fig. 9. First division metaphase (side view) showing two elements moving towards the same pole. Fig. 10. Late anaphase showing lagging bivalent. Fig. 11. Late anaphase showing sticky bridge. Fig. 12. Second division metaphase (polar view).

chiasma. Some multinucleated cells have also been observed at this stage.

The anaphase disjunctions are often encountered with a lagging bivalent (Fig. 10) and sticky bridges (Fig. 11).

The second division metaphase (Fig. 12) chromosomes are diagnostically smaller in size.

The authors express their thanks to the Principal, Dr. D. J. Reddy, for the encouragement and facilities and sincere gratitude to Dr. A. P. Kapur, Zoological Survey of India, for kindly identifying the specimen.

Department of Biology, J. DASGUPTA.
Jawaharlal Institute of MRS. GRACY BASILE.

Postgraduate Medical
Education and Research,
Pondicherry, March 10, 1966.

1. Stevens, N. M., *Carneg. Inst. Wash. Pub.*, 1906, 36, 32.
2. Seiler, J., *Chromosoma*, 1947, 3, 88.
3. Mukulska, I., *Experientia*, 1949, 5, 473.
4. Smith, S. G., *Can. Entom.*, 1950, 82, 58.
5. Suomalainen, E., *Chromosoma*, 1954, 6, 627.
6. Takenouchi, Y., *Japan J. Zool.*, 1955, 11, 425.
7. Smith, S. G., *Heredity*, 1953, 7, 31.

INDUCTION OF CLOSED ANTHAR CHARACTER IN TOMATO CULTIVARS PUSA RUBY, MONEY MAKER AND SIOUX

VARIOUS workers have shown the superiority of the hybrid tomatoes over the parent cultivars for increasing yield and earliness in tomato.¹⁻⁵ Being a self-pollinated crop, the hybrid seed production on commercial scale was found more expensive. For minimising the cost of hybrid seed production Lasley *et al.* (1958), and Rick (1949) have evolved the male sterile lines. The anther in these cases were shrunken but these lines were difficult to maintain. With the discovery of closed anther mutant by Larson and Paur,⁶ Mittal and Thomas⁷ and Nickeson⁸ in varieties, John Baer and Meeruti, the hybrid seed production have become easier.

An attempt was made at this Substation to produce hybrid seed from two closed anther mutants of John Baer and Potato leaf cultivars. They were tested for the combining ability with thirteen cultivars during the year 1961. From the studies it was concluded that both these closed anther types are very poor combiners. Later, in another trial seven promising cultivars, namely Money Maker, Pusa Ruby, Sioux, Marglobe, Red Jacket, Best of all and Ace were crossed in all possible combinations. From the

data collected, three cultivars, namely Pusa Ruby, Sioux and Money Maker, appeared to be good general combiners. The percentage increase in yield of the F_1 varied from 37.38 to 74.29 over the mean of parent and recommended cultivars. It was thought desirable that the closed anther character may be introduced in general good combiners like Pusa Ruby, Sioux and Money Maker. The closed anther character is monogenic, recessive and quite easy to transfer in other cultivars. In crosses of potato leaf type, plants with potato leaves and having closed anther were selected in F_2 bearing fruit characters like their respective male parent, while in the crosses of John Baer cut leaves with closed anther were selected. After 4 generations of continuous selection we have established homozygous lines which are like their respective male parent, namely Pusa Ruby, Money Maker and Sioux, in fruit characters but at the same time have got closed anther character. Lines so evolved were tested for the combining ability.

Preliminary trials conducted at this Station showed that the new lines thus evolved were very good combiners, even better than their male parent.

Thanks are due to Dr. S. K. Mukherjee for the facilities and encouragement for conducting these investigations.

Central Vegetable Breeding J. P. SINGH.
Substation (I.A.R.I.), H. S. GILL.
Katrai, Kulu Valley (Punjab), R. N. TEWARI.
January 17, 1966.

1. Gottle, R. C., "Greater yield and earlier fruit from hybrid tomato," *Agr. Gas.*, 1958, 67, 629.
2. Pal, B. P. and Sikka, S. M., "Exploitation of hybrid vigour in the improvement of crop plants, fruits and vegetables," *Indian J. Gen. and Pl. Bre.*, 1958, 16 (2), 98.
3. Haskel, G. and Brown, A. G., "Hybrid vigour in cultivated tomatoes," *Euphytica*, 1955, No. 4, 147.
4. Sedova, A. and Kimshnaseva, N., "Grow hybrid tomato seeds," *Potato and Vegetables*, 1960, No. 6, 52.
5. Breznev, D. C., "Heterosis in vegetable crops," *Zuchter*, 1963, p 134.
6. Larson, R. F. and Paur, S., "The description and inheritance of a functionally sterile flower mutant in tomato and probable value in hybrid tomato seed production," *Proc. Amer. Soc. Hort. Sci.*, 1948, 52, 365.
7. Mittal, S. P. and Thomas, T. A., "A functional sterile mutant in tomato var. Meeruti," *Indian J. Hort.*, 1961, 18, 150.
8. Nickeson, R. L., "Selection for combining ability in a male sterile tomato line having two recessive seedling genes," *Diss. Abstr.* 17, 1951, Publ. No. 22, 471, 1876.

REVIEWS AND NOTICES OF BOOKS

An Introduction to the Longitudinal Static Stability of Low-Speed Aircraft (*International Series of Monographs in Aeronautics and Astronautics Division. II. Aerodynamics, Volume 5*), By F. G. Irving. (Pergamon Press), 1966. Pp. viii + 143. Price 30 sh. net.

The author deals with the static longitudinal stability of low-speed aircraft: that is, specifically conventional rigid aeroplanes travelling at speeds which are such that compressibility effects are negligible. The theory is extended however to the interpretation of non-linear trim curves and covers all-moving tails. Subject to the restrictions implicit in the title, the object is to provide a detailed and reasonably exact mathematical treatment of the subject, explained as fully as possible in physical terms. The treatment is essentially a simplified version of a more general body of theory which nevertheless aims to main mathematical rigour. The usual approach involves some initial simplifying assumptions which simplify the mathematics at the expense of rendering it less precise and tending to obscure some physical principles. The aim has been to explain physical principles in rather greater detail than is found in the usual references. Chapter 4 represents something of an innovation, being a general treatment of longitudinal stability subject only to the condition that the tail lift curve slope is known. This approach has the advantage that particular cases (stick-fixed, stick-free, etc.) follow very easily.

Apart from acting as an introduction to more generalized treatments of the subject, the book will be of direct value to designers of small aeroplanes and gliders, and those engaged in flight testing.

C. V. R.

International Series in Pure and Applied Mathematics: Complex Analysis (Second Edition). By Lars V. Ahlfors. (McGraw-Hill Book Company, International Division, 330, West 42nd Street, New York, New York 10036), 1966. Pp. xiii + 317. Price \$ 8.95.

An introduction to the theory of analytic functions of one complex variable that emphasizes the foundations of the theory and presents them in concise and elementary steps. No mere collection of theorems nor catalogues of results, this book develops a genuine understanding for the theory.

Changes in the second edition reflect the increased sophistication of the student and his readiness to cope with abstraction.

- (i) There is more mature treatment of metric spaces and compactness and an improved version of the theory of normal families.
- (ii) A power series introduces exponential and trigonometric functions and a preliminary section describes the elementary properties of the power series.
- (iii) The section on elementary topology has been revised and enlarged to include all standard elementary notions. This will enlarge the student's outlook by providing a preliminary acquaintance with material covered in more advanced courses.
- (iv) An enlarged section on conformal mapping includes the Schwarz-Christoffel formula. This is an important illustration of methods and a link with practical applications.
- (v) A new section on elliptic functions introduces fundamental concepts and features an elementary approach to the modular function which is applied to give proof to the Picard Theorem.
- (vi) The exercise sections are better and larger. All the artwork is new.

C. V. R.

Advances in Control Systems (*Theory and Applications, Volume 2*). Edited by C. T. Leondes. (Academic Press, New York and London), 1965. Pp. x + 313. Price \$13.00.

The primary purpose of this series is to bring together current information from leading researchers in the ever-broadening field of automatic control. The large number of practising engineers, applied mathematicians, and other scientists being drawn into this field, together with the increase in student enrolment in systems engineering, ensures a steady flow of new results in the future. Those directly active in developing control theory, as well as those who use techniques of automatic control as an effective tool, will find this series invaluable as a comprehensive and readily accessible compilation of information. The teacher will find it a timely and convenient source to which to refer his students.

The contents of the volume are: D. G. Schultz, the Generation of Liapunov Functions; F. T. Smith, the Application of Dynamic Programming to Satellite Intercept and Rendezvous Problems; H. C. Hsieh, Synthesis of Adaptive Control Systems by Function Space Methods; C. D. Johnson, Singular Solutions in Problems of Optimal Control; Richard Allison Nesbit, Several Applications of the Direct Method of Liapunov.

C. V. R.

Precipitation from Iron-Base Alloys—*Metalurgical Society Conferences*, Volume 28. Edited by G. R. Speich and J. B. Clark. (Gordon and Breach, Science Publishers, 150, Fifth Avenue, New York, N.Y. 10011), 1966. Pp. viii + 412. Price: Paper \$8.50; Cloth \$21.00.

This volume represents the Proceedings of a Symposium sponsored by the Ferrous Metallurgy Committee, Institute of Metals Division, The Metallurgical Society, American Institute of Mining, Metallurgical, and Petroleum Engineers, held at Cleveland, Ohio, on October 21, 1963.

The titles of the papers contained in this volume are as follows: 1. Precipitation from Binary Substitutional Solid Solutions of Alpha Iron, by E. Hornbogen. Discussion, by C. R. Speich; 2. Precipitation from Substitutional Iron-Base Austenitic and Martensitic Solid Solutions, by R. F. Decker and S. Floreen. Discussion, by R. F. Pitler and L. Habraken; 3. Quench Aging in Fe-Mn-C-N Alloys, by J. E. Enrietto, M. G. H. Wells and E. R. Morgan; 4. A Study of the Tempering of Steel Using Transmission Electron Microscopy, by E. Tekin and P. M. Kelly. Discussion, by C. Altstetter, M. G. H. Wells and E. Smith; 5. Theory of Strengthening due to Precipitate Phases, by G. S. Ansell; 6. Interaction of Dislocations and Precipitates in Some Iron-Base Alloys, by A. K. Keh, W. C. Leslie and D. L. Sponseller; 7. Dispersion Strengthening of Iron, by K. M. Zwilsky, R. C. Nelson and N. J. Grant; 8. Effect of Precipitation on Magnetic Properties of Iron-Base Alloys, by E. A. Nesbitt and A. J. Williams; 9. Precipitation in Iron-Base Alloys—State of Art, by M. Cohen.

C. V. R.

Introduction to General Topology. By Sze-Tsen Hu. (Holden-Day, Inc., 728, Montgomery Street, San Francisco), 1966. Pp. x + 230. Price \$9.35.

This text provides a systematic introduction to general topology geared to the training of mathematicians specializing in analysis as well

as in algebra or topology. The book is designed for upper division undergraduates or first-year graduate students who have had two or three years of sound undergraduate mathematics study.

Marked by a careful and painstaking presentation, the first three chapters cover the more or less standard material on topological spaces with emphasis on absolutely basic concepts, fundamental properties, and important constructions. Proofs are presented in as intelligible a manner as possible and examples are carefully chosen to follow the main lines of development.

The fourth chapter offers a rather elaborate coverage of metrizable and metric spaces, including completeness and completions. Chapter V presents an axiomatic approach to uniformity and boundedness, the latter for the first time in book form. The final chapter treats topological linear spaces, including normed linear spaces and normability. A comprehensive bibliography of books on general topology, together with a list of relevant papers, concludes the text.

C. V. R.

Animal Gametes—A Morphological and Cytochemical Account of Spermatogenesis. By Viswa Nath. (Asia Publishing House), 1965. Pp. xvi + 162. 184 Figures. Price Rs. 50.0.

In this book the author has provided a comprehensive morphological and cytochemical account of spermatogenesis in a large number of species with particular reference to the cytoplasmic inclusions such as the Golgi bodies, mitochondria, centrioles and axial filaments, chromatoid bodies, etc. He has also included observations with light and electron microscopy and, in several cases, has made an attempt to correlate such observations.

All cytologists especially interested in the structure and physiology of gametes will find this a useful compendium of the available literature on the subject.

C. V. R.

A Collection of Problems in Atomic and Nuclear Physics. By I. Ye. Irodov. (Pergamon Press), 1966. Pp. x + 239. Price 60 sh. net.

The collection of some 850 problems contained in this book is intended for students commencing a study of the elements of atomic and nuclear physics. The topics include the theory and application of Planck's law of radiation; the De Broglie relation and its applications; Bohr theory of the atom; Introduction to Schrodinger's equation; the properties of many electron atoms and molecules; basic pheno-

menology of nuclei; elementary relativistic kinematics and elementary particles. Many numerical examples are given of the applications of the fundamental formulæ of the subject. An important feature of the book is the provision of a set of very comprehensive answers to the problems, including derivations of the important theoretical facts and formulæ.

The book will prove a useful adjunct to the standard text-books at the introductory level. It will be of value to undergraduates taking courses in physics at both ordinary pass and honours levels. It will also prove useful to University students taking physics as an ancillary subject and to Diploma students in physics at technical colleges. C. V. R.

Hormonal Steroids (Vol. 2). Edited by L. Martini and A. Pecile. (Academic Press, New York and London), 1965. Pp. xxi + 673. Price \$20.00.

It is over thirty years since the isolation and chemical identification of the first hormonal steroid (estrone). There followed in the 1930's a brilliant series of investigations which led to the identification of most of the major steroids secreted by the ovaries, the testes, the adrenal cortex, and the placenta. Since those days, when these steroids were available at best in milligram amounts, there has been an exponential increase in the amounts of steroid hormones preparable by partial synthesis and in the investigation of their pharmacological, physiological, and biochemical properties. Keeping pace with, and, indeed, often preceding our knowledge of the steroid hormones, has been the production of derivatives, analogies, and homologues of the hormones. In order to encompass the rich chemical, biochemical, and medical knowledge in the steroid hormone field, the inclusion of work with these steroid relatives led to the "International Congress on Hormonal Steroids". Our knowledge of the regulatory activity of the steroid hormones at the organ, tissue, and cellular levels has been aided and enlarged by studies with the synthetics, and their contribution to the sharpened insight is obvious in numerous papers presented to this Congress, and included in this volume.

In this volume, the reader will find able presentations by experienced and sagacious investigators of the what, how, and why of the multivarious steroid activity. C. V. R.

Annual Review of Phytopathology (Vol. 3). (Annual Reviews, Inc., 231 Grant Avenue, Palo Alto, California, 94306), 1965. Pp. 423. Price \$9.00.

Volume 3 of this well-known series contains the following articles: Toxins and Cell-Wall Dissolving Enzymes in Relation to Plant Disease, by William Brown; Serology in Virus-Disease Diagnosis, by C. Wetter; Factors in Survival of Nematodes, by S. D. Van Gundy; Deterioration of Stored Grains by Fungi, by C. M. Christensen and H. H. Kaufmann; Problems in Speciation of Phytopathogenic Pseudomonads and Xanthomonads, by Heinz Stolp, Mortimer P. Starr, and Nancy L. Baigent; Histochemistry of Foliage Diseases, by Naoji Suzuki; Plant Virus Inclusions, by Frank P. McWhorter; Inhibition of Cellulases, by Mary Mandels and Elwyn T. Reese; Metabolic Aspects of Spore Germination in Fungi, by Paul J. Allen; Microclimate and Plant Disease, by Paul E. Waggoner; Environmental Relationships in the Powdery Mildews, by W. C. Schnathorst; Fate of Fungicides in Plants, by A. Kaars Sijpesteijn and G. J. M. van der Kerk; Adaptation of Fungi to Metal Toxicants, by Joji Ashida; Low-Volume Spraying, by Robert H. Fulton; Disease Control through Virus-Free Stock, by M. Hollings; Use of Environmental Factors in Screening for Disease Resistance, by J. C. Walker; Epiphytic Micro-organisms in Relation to Plant Disease, by Curt Leben.

C. V. R.

The Biological Significance of Climatic Changes in Britain. Edited by C. G. Johnson and L. P. Smith. (Academic Press, London and New York), 1965. Pp. x + 222. Price 42 sh.

There are numerous indications that the climate of Britain is changing. Over the next twenty to thirty years these changes may be very significant to agriculture and to the distribution of animals and plants. With the advent of long-term weather forecasting, farming operations may well be approached with more knowledge than formerly of what the seasons are going to be like. There is thus a need to discuss the problems that may be involved, and the possible uses of long-term weather forecasts from season to season within a general context of very slowly changing climate over the years. These problems are of vital interest not only to agriculturalists but also to conservationists and to all interested in field biology. This volume brings together articles in various disciplines which should

interest meteorologists, agriculturalists, horticulturalists, naturalists and economists.

C. V. R.

Organosilicon Compounds. By V. Bazant, V. Chvalovsky and J. Rathousky. (Publishing House of the Czechoslovak Academy of Sciences, and Academic Press, New York and London).

Vol. 1: *Chemistry of Organosilicon Compounds.* Pp. 616. Price \$25.

Vol. 2—Part 1: *Register of Organosilicon Compounds.* Pp. 699. \$25.

Vol. 2—Part 2: *Register of Organosilicon Compounds.* Pp. 544. \$25.

(Special Price for complete set \$70.)

The two chief characteristic features which differentiate silicon organic chemistry from that of carbon are (1) its lower electronegativity and (2) its ability to utilize the 3d-orbitals for bond formation. This 3-volume compilation is primarily intended for research workers in the field of organosilicon chemistry. The bulk of the monograph, namely, the two parts of Volume 2, consists of a register of organosilicon compounds listing their most important constants. In addition the authors have attempted in Volume 1, to survey the types of reactions which have been used in the preparation of organosilicon compounds or to which they have been subjected, and the physico-chemical methods applied to them.

In the Register the compounds are arranged according to their summary formulæ. The information given against each compound is in the following order: name of compound, structural formula, physical data, methods of synthesis, reactions, calculated elementary percentage composition, and calculated molecular weight. Also given are derivatives, salts, and compounds containing labelled elements. The authors have taken care to rectify the errors detected in the original literature. A. S. G.

Advances in Heterocyclic Chemistry (Vol. 4). Edited by A. R. Katritzky. (Academic Press), 1965. Pp. 462. Price \$15.

The major article in this continuing series on advances in heterocyclic chemistry is the one on Reactivity of Azine, Benzoazine, and Azinoazine derivatives with simple nucleophiles by R. G. Shepherd and J. L. Fedrick (Pp. 145-423). The relative reactivity of different positions in azines towards nucleophiles is an

interesting problem which though not yet solved has produced much literature in recent years. The authors discuss results on carboaromatics for postulating the behaviour of azines and attempt to arrive at a fundamental reactivity pattern of azines and point out general principles.

There are two articles on Covalent hydration in Nitrogen-containing Heteroaromatic compounds, the first on qualitative aspects by A. Albert and W. L. F. Armarego, and the second on quantitative aspects by D. D. Perrin. Recent advances in Oxazolone chemistry is reviewed by Robert Filler. The other two articles are Isothiazoles by R. Slack and K. R. H. Wooldridge, and Hetarynes by H. J. den Hertog and H. C. van der Plas. A. S. G.

A Hundred Years of Chemistry. By Alexander Findlay and Trevor Williams. (University Paperbacks, published by Methuen and Co. Ltd., 11, New Fetter Lane, London E.C.4), 1965. Pp. 335. Price 25 sh. net.

This is the third edition, revised by T. I. Williams, of the original well-known publication of Professor Findlay, which has established itself as an "invaluable and readable history of chemistry". In the revised edition Professor Williams has brought the book up to date by indicating the main lines of advance and the more important results obtained. A. S. G.

Books Received

Desert Life. By J. L. Cloudsley-Thompson. (Pergamon Press, London), Pp. ix + 86. Price 10 sh.

Osmotic Regulation in Aquatic Animals. By A. Krogh. (Dover Publications, New York), 1965. Pp. 242. Price \$1.75.

A Collection of Problems in Atomic and Nuclear Physics. Edited by S. Doniach. (Pergamon Press, London), 1966. Pp. x + 239. Price 60 sh.

Advances in Mathematics (Vol. I, No. 3). Edited by H. Busemann. (Academic Press, New York), 1965. Pp. xi + 265-450. Price \$6.50.

Quantum Mechanics and Path Integrals. By R. P. Feynman and A. R. Hibbs. (McGraw Hill Book Company, 330, West 42nd St., New York), 1965. Pp. xiv + 365. Price \$12.50

Advances in Chemotherapy (Vol. 2). Edited by A. Goldin, F. Hawking and R. J. Schnitzer. (Academic Press, New York), 1965. Pp. x + 330. Price \$13.00.

THE NEW PHYSIOLOGY OF VISION

Chapter XLIII. The Colours of Fluorspar

SIR C. V. RAMAN

FLUORSPAR is outstanding amongst minerals for its varied displays of colour. Of particular interest are the nuances of colour, which vary from a very light to a deep yellow, from the palest to the darkest violet, from a very light green to a saturated greenish-blue. The colours of fluorspar and the fact that it crystallises beautifully forming cubes or octahedra either as individuals or as clusters or as interpenetrating aggregates result in making the museum specimens of the mineral very attractive objects.

The origin of the colours displayed by fluorspar is a problem of great scientific interest. It is evident that the problem does not stand by itself but is linked with other properties of the material and especially the luminescence which fluorspar displays. For, the emission of visible light as the result of irradiation by ultra-violet rays is possible only if the material is, in the first instance, capable of absorbing the incident radiation. The manifestations of colour and of luminescence are therefore connected phenomena and it is not surprising to find that the luminescence displayed by fluorspar varies enormously in brightness from specimen to specimen, and that there are also noticeable differences in the colour, in other words, of the spectral composition of the emitted radiation. It is also not surprising that these variations in the brilliancy and colour of the emission are correlated with the colour of the specimen as seen by daylight. It is worthy of note in this connection that colourless specimens of fluorspar as well as optical fluorite prepared by slow crystallisation from purified material also exhibit the blue-violet glow under an ultra-violet lamp. But such luminosity is, in general, feeble in comparison with the brilliant displays put up by some of the naturally occurring fluorspars.

The observed relationships between colour and luminescence suggest that both phenomena may have a common origin. Further, since the luminescence is exhibited also by the synthetically prepared crystals of fluorite, there are grounds for presuming that the phenomenon is a characteristic property of the material itself connected with its crystal structure, and is not due to the presence of extraneous impurities. This presumption is strengthened when we recall

the fact, long known to mineralogists, that though fluorspar crystallises in the cubic system and should therefore be optically isotropic, nevertheless, plates of the substance viewed between crossed polaroids frequently display a feeble but readily observable birefringence. This manifests itself as a network of criss-crossing lines running parallel to the cubic planes of the crystal. This is a clear indication that the natural fluorspar has a lamellar structure, instead of the complete homogeneity characteristic of an ideal crystal. Miers, in his well-known treatise on mineralogy, remarks as follows: "No relation has been traced between the colour and composition of the mineral and there is no evidence that the birefringent lamellæ are due to alternation of isomorphous compounds or to zones of varying composition."

The foregoing remarks are intended to provide the background for an understanding of the particular aspect of the subject with which we are concerned here, *viz.*, the relation between the visually perceived colour of fluorspar and the spectral composition of the light which emerges from it after traversing a sufficient thickness of the material. What follows is essentially a factual report of the results of a study of the extensive collection of fluorspars which find a place in the museum of the author's research institute. This collection, acquired in the course of years, includes specimens from several different countries, including India. It received noteworthy additions when the discovery in the year 1962 of substantial fluorspar deposits at Amba Dongar in the Baroda District of Western India enabled the author to obtain numerous specimens from that area. Colourless and transparent specimens of fluorspar as well as specimens exhibiting a variety of colours are to be found in the museum.

Green Fluorspar.—Perhaps the most interesting exhibits in the collection are three specimens of Chinese art sculptured from green fluorspar. One of them is 6 cm. in height and represents a human figure seated on a flat pedestal and holding a ball in each hand. The material is fairly clear and is of a bright green colour. The second is a larger piece about 16 cm. high, which represents a mythical

animal resembling a fish on the back of which is seated a human figure holding up a flag with both arms. The colour of the material is also green, but distinctly paler than the first specimen. The third work is a massive specimen about 25 cm. \times 25 cm. \times 15 cm. in its dimensions. It represents a pastoral scene and is covered with elaborate carvings which need not here be described in detail. The colour of the specimen is mostly a bright green, but there are also some parts which are of a paler hue and some parts which are distinctly bluish in colour.

Examination of the first specimen which transmits light of a bright green colour shows that this colour has its origin in the practically complete extinction of the yellow region in the spectrum in the wavelength range from 570 $m\mu$ to 590 $m\mu$ while the green from 500 $m\mu$ to 560 $m\mu$ remains in practically full strength. The blue sector of the spectrum is much weakened but is not totally extinguished. On the other hand, the red sector from 600 $m\mu$ to the end of the spectrum, though diminished in intensity, continues to be conspicuously visible.

The foregoing statement describes in the main what is noticeable also with the numerous other specimens in the collection exhibiting a green colour. The only qualification necessary is that the extinction of the yellow sector of the spectrum becomes less complete when the green colour exhibited by the fluorspar is less saturated. We may mention as an example, a crystal of octahedral form in the collection which exhibits a pale green hue. The spectrum of the light which has traversed the crystal through a pair of opposing faces and an absorption path of 4 cm. shows the weakening of the yellow sector in a striking fashion, but it is by no means in the nature of a complete extinction. The blue sector is also reduced in its intensity but continues to be visible, while the green and red sectors both remain conspicuous, the former being definitely the brighter of the two.

The Purple Octahedron.—A crystal of octahedral form with an edge-length of 1.5 cm. and with lustrous faces is one of the items of spectral interest in the collection. Seen by transmitted light, it resembles amethystine quartz, though the colour is not very deep. The spectrum of the light transmitted through a pair of opposing faces showed the blue, green and red sectors with the same brightness relatively to each other as normally, but the regions between 560 $m\mu$ and 600 $m\mu$ which is

the yellow sector is much weakened so much so that the presence of this colour in the spectrum is scarcely recognisable.

Two massive pieces of almost colourless fluorspar in the collection exhibit large areas in which the light which has filtered through exhibits a purplish hue. In both cases, the spectroscope reveals that in this area, there is a weakening or nearly complete extinction of the yellow sector, while the other regions of the spectrum retain their normal relative intensities.

The Blue Octahedron.—Another interesting item in the collection is a perfect octahedron of edge-length 1.5 cm. which is quite clear and transparent and has lustrous faces, and which when placed on a white sheet of paper appears of a sky-blue colour. Spectroscopic examination shows that the light which has traversed the crystal through a pair of opposing faces shows an extinction of the yellow sector, while a distinct weakening of the red sector relatively to the green and the blue sectors is also noticeable.

The Yellow Octahedron.—This crystal which is octahedral in form with an edge-length of 2 cm. has lustrous faces but exhibits internal defects which prevents a free transmission between its opposing faces. It is definitely yellow in colour. The light which filters through it when examined spectroscopically shows a practically complete extinction of the blue sector, and remarkably enough also of the yellow sector in the spectrum, while the green and red sectors come through freely. Thus, we infer that the yellow colour exhibited by the crystal is a "synthetic yellow" resulting from a superposition of the red and green parts of the spectrum passing through it.

Fluorspar of Optical Quality.—Included in the collection are two specimens which are extremely clear, in other words, free from all observable cloudiness within the volume of the crystal. One of the pieces is pyramidal in shape, 10 cm. long and 7 cm. broad at the base, allowing a clear optical path through it of that length. The other piece is smaller, but permits of light passing through it freely in two directions, the path lengths being 4 cm. and 3 cm. respectively. The interesting feature in both cases is that the transmitted light along these optical paths is of a very pale yellow colour. The spectroscope reveals that this is due to an extinction of the violet end of the spectrum beyond 430 $m\mu$ and a distinct weakening up to 460 $m\mu$. At greater wavelengths, there is perfect transparency.

Some Remarks Concerning Luminescence.—We may usefully here record some notes regarding the behaviour under the ultra-violet lamp of the various individual specimens referred to above.

The three Chinese works of art of green fluorspar all showed a blue-violet glow of considerable intensity. The octahedron of a pale green hue showed a violet-coloured luminescence of much smaller intensity.

The purple and blue octahedra both exhibit a feeble luminescence of a violet colour, as also

the massive specimens which allow light of a purplish light to filter through.

The two very clear pieces of fluorspar also exhibit luminescence, that of the smaller specimens being particularly brilliant. This suggests that the pale yellow colour exhibited by these specimens is due to the absorption at the violet end of the spectrum associated with luminescence.

The most remarkable case of all is the yellow fluorspar which exhibits a bright luminescence exhibiting a colour similar to that of the specimen itself.

FINE STRUCTURE ANALYSIS OF $^{63}\text{Cu } ^{127}\text{I}$ BANDS

P. RAMAKOTESWARA RAO AND K. V. S. R. APPA RAO

Spectroscopy Division, Atomic Energy Establishment, Trombay, Bombay

MANY molecules occur as mixtures of several isotopic species in nature. It is very difficult or impossible, especially if the molecule is heavy, to analyse the fine structure of the band spectra of such molecules even with the highest dispersions and resolutions now available. Obviously the analysis will become considerably easier if the spectrum of only one isotopic species could be investigated. Such investigations became possible in the last few years with the availability of separated isotopes and the development of sealed electrodeless discharge tubes¹ which require only milligram quantities of the substance.

Thus, for instance, the fine structure analysis of the band systems of CuCl , consisting of four isotopic species, was carried out by the author² using separated isotopes of copper and chlorine. In continuation of these investigations the fine structure of the bands of $^{63}\text{Cu } ^{127}\text{I}$ molecule [natural CuI consists of two isotopic species $^{63}\text{Cu } ^{127}\text{I}$ (69%) and $^{65}\text{Cu } ^{127}\text{I}$ (31%)] has been analysed and the results of the analysis are reported in this note.

^{63}CuI was prepared by directly reacting in vacuum at high temperature copper (^{63}Cu —99.8%) and iodine. Electrodeless discharge tubes containing milligram quantities of ^{63}CuI were prepared in the manner described in reference 1. The bands were obtained by exciting the electrodeless tube, heated by a furnace to a temperature of 600 to 800° C., by a microwave oscillator (2450 mc./sec.). The bands were photographed in the second order

of the 6.6 meter, 1,200 lines per mm. concave grating spectrograph, at a dispersion of about 0.5 Å/mm.

Bands belonging to three systems *C*, *D* and *E*, out of the four known³ band systems of the molecule, have been analysed. Bands, whose fine structure has been analysed, are listed in Table I. Figure 1 shows a typical spectrum.

TABLE I
Bands of $^{63}\text{Cu } ^{127}\text{I}$ molecule whose fine structure has been analysed

System	Bands analysed
<i>C</i> system ($C^1\Sigma - X^1\Sigma$)	4574.8 Å (0-0); 4630.7 Å (0-1); 4687.5 Å (0-2)
<i>D</i> „ ($D^1\Pi - X^1\Sigma$)	4359.6 Å (0-0); 4410.3 Å (0-1); 4461.9 Å (0-2); 4514.4 Å (0-3)
<i>E</i> „ ($E^1\Sigma - X^1\Sigma$)	4168.2 Å (0-0); 4214.5 Å (0-1); 4261.4 Å (0-2); 4309.4 Å (0-3); 4358.1 Å (0-4); 4174.4 Å (1-1); 4129.0 Å (1-0); 4090.9 Å (2-0); 4141.9 Å (3-2)

The rotational analysis indicates that the *C*, *D* and *E* band systems involve respectively $^1\Sigma - ^1\Sigma$, $^1\Pi - ^1\Sigma$ and $^1\Sigma - ^1\Sigma$ transitions. The bands of the *C* and *E* systems are single-headed and their structure consists of either two series of lines, the *P* and *R* branches or one series of lines. In the bands showing only one series of lines, the *P* and *R* branches coalesce, as the analysis shows. The bands of the *D* system

are double-headed. The structure between the two heads, consisting of R lines, is not resolved; the resolved structure shows two series of lines, the Q and the P branches. The members of the Q branch are uniformly more intense than the members of the P branch. The returning R branch gets too weak already at the band origin and cannot be traced beyond it, therefore, only the lines of Q and P branches are measured.

$C \ ^1\Sigma$ state 1080 cm^{-1} below it and the $E \ ^1\Sigma$ state 1050 cm^{-1} above it. The negative sign of the Λ -doubling constant q indicates that, compared to the $C \ ^1\Sigma$ state, the $E \ ^1\Sigma$ state plays a larger role in the Λ -doubling of the $D \ ^1\Pi$ state. This is understandable because at the J values involved ($J = 50$ to $J = 80$) the energy levels of the $D \ ^1\Pi$ state are considerably closer to the $E \ ^1\Sigma$ state (800 cm^{-1} to 450 cm^{-1}) than to the $C \ ^1\Sigma$ state (1300 cm^{-1} to 1700 cm^{-1}).

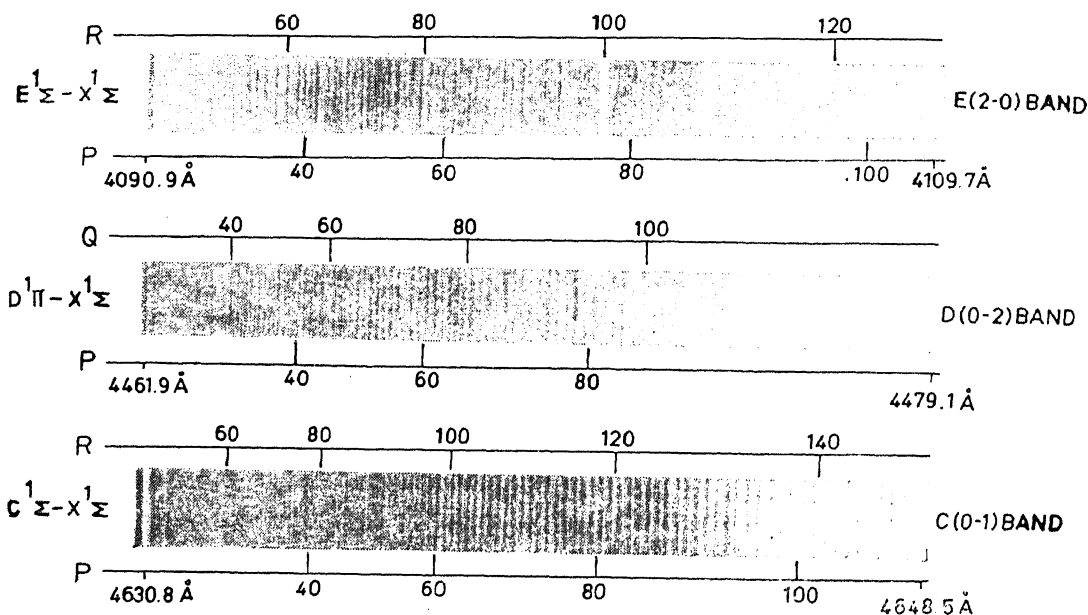


FIG. 1. Bands of $^{63}\text{Cu } ^{127}\text{I}$.

Due to the high temperature of the emission source and the relatively small B_v values involved in the bands, members with low J values are not observed in the different branches and this necessitated a large extrapolation in arriving at the J numbering. To ensure that correct J numbering is obtained, the rotational constants D' and D'' have also been included in the appropriate formulae used to check the correctness of the numbering. Though only two branches could be measured for the D bands, since more than one band could be analysed, it was possible to obtain the J numbering from internal evidence only. The fine structure analysis also confirms that the three systems have a common lower state, the ground state of the molecule.

The Λ -doubling in the $D \ ^1\Pi$ state is very small; the value of q being about -0.0001 . This $^1\Pi$ state has a $^1\Sigma$ state on either side of it—the

The rotational constants obtained from the present analysis are shown in Table II. Details will be published elsewhere.

TABLE II
Rotational constants of $^{63}\text{Cu } ^{127}\text{I}$ molecule

State	B_0 (cm^{-1})	$a \times 1000$ (cm^{-1})	$D_0 \times 10^{-7}$ (cm^{-1})	$q^{av} \times 10^4$ (cm^{-1})	λ_0 Å
$E \ ^1\Sigma$	0.0392	0.25	≈ 0.9	..	2.117
$D \ ^1\Pi$	0.0911*	..	..	-1.0	2.096
$C \ ^1\Sigma$	0.0919	..	≈ 0.9	..	2.086
$X \ ^1\Sigma$	0.0969	0.32	≈ 0.5	..	2.032

* B_0^d .

The authors are highly indebted to Professor R. K. Asundi and Dr. N. A. Narasimham for valuable discussions.

1. Ramakoteswara Rao, P. and Brody, J. K., *J. Chem. Phys.*, 1961, **35**, 776.
2. —, — and Asundi, R. K., *Can. J. Phys.*, 1962, **40**, 1443 and other papers referred therein.
3. Ritschl, R., *Z. Phys.*, 1927, **42**, 172.

HYDROGEN-BONDING IN PYRROLE-TERTIARY AMIDE COMPLEXES

K. VENKATA RAMIAH AND V. VENKATA CHALAPATHI

Department of Physics, University College of Science, Osmania University, Hyderabad-7, A.P.

KARTHA *et al.*¹ studied hydrogen-bonding between alkyl sulphonyl compounds and *p*-chlorophenol and estimated the strengths of the hydrogen bonds. In this note, we report the studies of hydrogen-bonding between some tertiary amides and pyrrole (N—H...O=C type bond) and discuss the strengths of the hydrogen bonds from the positions of the free N—H stretching absorption band of pyrrole in solutions of CCl₄ and the bonded N—H stretching frequency of the same compound in the presence of dimethyl and diphenylamides. The tertiary amides used in this work are dimethyl formamide, dimethyl acetamide, diphenyl formamide and diphenyl acetamide. The infra-red spectra of the N—H stretching band of pyrrole was recorded with Perkin Elmer Model 221 infrared spectrophotometer with matched quartz cells of 1 cm. thickness. A spectral slit width of 2 cm.⁻¹ was used in this region. The concentration of pyrrole was varied from 0.00133 molar to 0.004 molar and the amide concentration was maintained at about 0.032 molar. The spectra were recorded at 23° C. under the following conditions:

- Solvent in the reference and sample beams.
- Amide and pyrrole in solution of CCl₄ in the sample beam and amide in CCl₄ in the reference beam.
- Pyrrole at the same concentration as in (ii) in the sample beam and solvent in the reference beam.
- Amide in CCl₄ in both the beams.

The spectra in the N—H stretching region of pyrrole, pyrrole-dimethyl acetamide and pyrrole-diphenyl acetamide complexes are shown in Fig. 1.

To calculate the equilibrium constant, we have used the expression

$$K_1 = \frac{M_p \cdot \gamma}{(M_A - M_p + \gamma) \gamma}$$

where M_p and M_A are the initial concentrations of pyrrole and the amide, and $\gamma = (a-c)/m$ where 'a' is the absorbance of the free N—H stretching band in the presence of the amide, and 'm' and 'c' are the slope and the intercept of the analytical curve obtained by plotting the absorbance of the free N—H stretching absorption band of pyrrole *versus* concentration in solu-

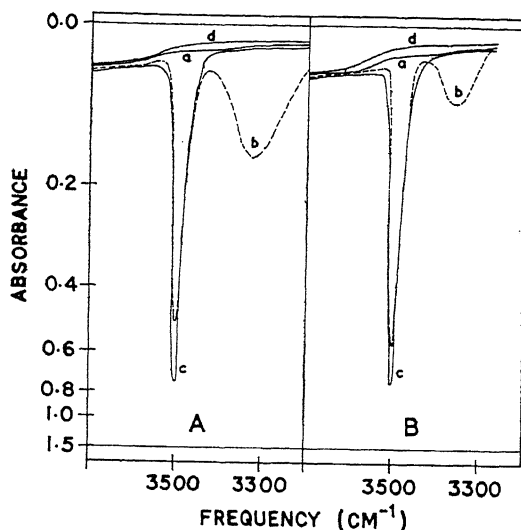


FIG. 1. A: (a) Carbon tetrachloride in both the sample and reference beams. (b) Solution of pyrrole (0.004 molar) and dimethyl acetamide (0.032 molar) in CCl₄ in the sample beam and the amide of same concentration in CCl₄ in the reference beam. (c) Pyrrole (0.004 molar) in CCl₄ in the sample beam and CCl₄ in the reference beam. (d) Dimethyl acetamide (0.032 molar) in CCl₄ in both the sample and reference beams. B: Same as in A with diphenyl acetamide in place of dimethyl acetamide.

tions of CCl₄. The hydrogen bond formation was assumed on the basis of 1:1 complex. These results are given in Tables I and II.

TABLE I

Equilibrium constants of pyrrole-dimethyl acetamide and pyrrole-diphenyl acetamide complexes

Initial molar concentration in CCl ₄ of			Absorbance of			K_{DMA}	K_{DPA}
Pyrrole	Dimethyl acetamide	Diphenyl acetamide	Free N—H stretch in CCl ₄	Free N—H stretch in presence of Dimethyl acetamide	Free N—H stretch in presence of Diphenyl acetamide		
0.004	0.0324	0.0313	0.70	0.48	0.54	16.0	11.0
0.002	0.0320	0.0311	0.37	0.25	0.29	17.0	11.0
0.00133	0.0320	0.0309	0.25	0.18	0.19	16.0	12.0

TABLE II
Equilibrium constants of pyrrole-dimethyl formamide and pyrrole-diphenyl formamide complexes

Initial molar concentrations in CCl ₄ of			Absorbance of			K _{DMF}	K _{DPhF}
Pyrrole	Dimethyl formamide	Diphenyl formamide	Free N-H stretch in CCl ₄	Free N-H stretch in the presence of			
				Dimethyl formamide	Diphenyl formamide		
0.004	0.0329	0.0345	0.70	0.52	0.59	11.3	6.4
0.00267	0.0329	0.0343	0.47	0.36	0.41	11.5	6.3
0.0020	0.0329	0.0343	0.37	0.28	0.30	11.4	7.4

The free N—H stretching frequency and the bonded N—H stretching frequencies in various complexes are given in Table III.

TABLE III

Complex	N-H stretching frequency of pyrrole (cm. ⁻¹)	
	Free N-H stretch	Bonded N-H stretch
Pyrrole-dimethyl acetamide	3500	3328
" diphenyl "	3500	3362
" dimethyl formamide	3500	3350
" diphenyl "	3500	3381

The observations in Tables I, II and III indicate that the frequency difference between the free and bonded N—H stretching frequencies and the value of the equilibrium constants in case of pyrrole-dimethyl amide complexes are

higher than the values of the same quantities in case of the corresponding pyrrole-diphenyl amide complexes. These results show that the hydrogen-bonding in the pyrrole-dimethyl amide complexes is stronger than that in the corresponding pyrrole-diphenyl amide complexes. In amides where there are two possible resonance structures, the authors² discussed in their earlier work that the dipolar resonance structure makes substantial contribution to the ground state of the molecule. In the LCAO-MO terms, Cannon^{3,4} discussed the interaction and the mixing of the π -orbitals of C=O and the lone pair orbital of the N atom from 2P_z atomic orbitals in the O=C—N group and concluded that this π -P interaction is responsible for the high polarity of the group. But in diphenyl amides, there is a competitive effect of the phenyl ring for the lone pair of electrons on the nitrogen atom with the result that the contribution of the dipolar resonance structure to the ground state of the molecule is considerably reduced in these molecules. This explains the manifestation of weaker hydrogen-bonding in the pyrrole-diphenyl amide complexes compared to that in the corresponding pyrrole-dimethyl amide complexes.

One of us (V. V. C.) is grateful to the University Grants Commission, Government of India, for the award of a Research Fellowship.

1. Kartha, V. B., Norman Jones, R. and Robertson, R. E., *Proc. Ind. Acad. Sci.*, 1963, **58**, 216.
2. Venkata Ramiiah, K. and Venkata Chalapathi, V., *Ibid.*, 1963, **58**, 233.
3. Cannon, C. G., *Microchimica Acta*, 1955, **2**, 555.
4. —, *J. Chem. Phys.*, 1956, **24**, 491.

THE 'IN VIVO' MECHANISM OF LIPOLYSIS OF PEA-NUT AND COTTON SEED FATS

J. M. S. MATHUR

Division of Botany, Indian Agricultural Research Institute, New Delhi

THE currently accepted hypothesis about lipolysis of triglycerides is a stepwise reaction involving degradation of a triglyceride molecule through 1, 2-/1, 3-diglyceride, 2-monoglyceride and 1-monoglyceride with liberation of one mole of fatty acid at each step. *In vivo* and *in vitro* studies by various authors¹⁻⁵ support this theory.

While much literature is available in favour of the stepwise hydrolysis of triglycerides, the same is not true about one-step 'quantum'

mechanism of hydrolysis of triglycerides recently put forward by Kartha and Mathur.⁶ According to them a triglyceride molecule is directly converted into glycerol and fatty acids without intermediate liberation of di- and monoglycerides, since no appreciable increase in acetyl value of remnant fat, as otherwise expected, at different stages of fat mobilization in germinating gingili and mustard seeds, could be detected.

This is not in agreement with *in vitro*

studies. Therefore, it appears that the pathway of lipolysis of triglycerides differs *in vivo* and *in vitro*. This prompted the author to undertake the present investigations.

Pea-nut kernels (*Arachis hypogea*) and dehusked cotton seeds (*Gossypium virnar*) were germinated in Minnesota Seed Germinator maintained at 30° C. At different intervals, a known number of seedlings were taken, washed free of sand, drained and dried, followed by oil extraction by cold percolation¹⁰ using carbon tetrachloride.

Kartha and Mathur's method¹¹ was adopted for gravimetric determination of acetyl values throughout the course of these studies. The results are summarized in Table I. The acetyl values given by various authors for the original seed oils are indicated in Table II.

TABLE I

Results of studies on germinating Pea-nut and cotton-seeds

Stage	Number of seeds/seedlings	Dry weight (gm.)	Oil %	Oil mobilized %	Acetyl value	Unsaponifiable matter %
Pea-nut						(Rabari et al. ¹⁶)
Original seeds	2	1.3500	42.9	Nil	7.1	0.3
3 days	3	1.5078	35.5	17.3	9.4	0.4
5 "	5	2.0200	24.5	42.9	11.7	0.6
7 "	5	1.9640	16.2	62.3	11.7	0.6
8 "	6	2.0220	8.2	80.9	15.1	0.65
Cotton seed						(Author)
Original seeds	30	1.3096	17.4	Nil	9.9	0.72
3 days	28	0.9885	14.6	16.1	9.2	0.76
5 "	37	0.8101	11.0	36.8	8.9	0.76
7 "	52	0.7864	6.3	63.8	10.6	0.77
8 "	87	0.9024	2.8	84.0	10.1	0.78

TABLE II
Acetyl values

Oil	A.O.C.S. ¹²	Lewkowitsch ¹³	Roberts and Shuette ¹⁴	Helrich and Reiman ¹⁵	Author
Pea-nut oil	7.5-12.5	..	5.5	..	7.1
Cotton-seed oil	8.5- 9.5	9.1	..	12.5	9.9

It is observed that in pea-nut the acetyl value gradually increases with increase in fat mobilization and that this increase is proportional to the increase in percentage of unsaponifiable matter. This increase in acetyl value is not sufficient enough to prove presence of any appreciable amounts of di- and monoglycerides at any stage. An almost steady acetyl value in case of cotton seed fat is probably due either to, no increase in percentage of unsaponifiable matter or increase of a component having negligible acetyl value.

The present note provides evidence in support of one-step pathway of *in vivo* lipolysis of triglycerides.

The author is grateful to Dr. A. B. Joshi, Director, and Dr. M. S. Swaminathan, Head, Division of Botany, for kindly providing all facilities.

- Mattson, F. H., Benedict, J. H., Martin, J. B. and Beck, L. W., *J. Nutrition*, 1952, **48**, 334; *Ibid.*, 1954, **52**, 575.
- Blankenhorn, D. H. and Ahrens E. H., Jr., *J. Biol. Chem.*, 1955, **212**, 69.
- Desnuelle, P. and Constantin, J. H., *Biochim. et Biophys. Acta.*, 1952, **9**, 531.
- Frazer, A. D. and Sammons, H. G., *Biochem. J.*, 1954, **39**, 122.
- Borgstrom, B., *Biochim. et Biophys. Acta*, 1954, **13**, 491.
- Solungen, N. L., *Proc. Acad. Wet., Amst.*, 1911, **73**, 1200.
- Krauss, M., *Z. angew Chem.*, 1911, **24**, 829.
- Armstrong, E. F. and Gosney, H. S., *Proc. roy. Soc.*, 1914-15, **88 B**, 176.
- Kartha, A. R. S. and Mathur, J. M. S., *J. Sci. Ed. Agric.*, 1964, **12**, 869.
- and Sethi, A. S., *J. Sci. and Ind. Res.*, 1956, **15 B**, 102; *Ibid.*, 1957, **27**, 211.
- and Mathur, J. M. S., *Indian J. Chem.*, 1963, **1**, 494.
- Mehlenbacher, V. C., *A.O.C.S., Official and Tentative Methods*, e.i., Table II, 1946.
- Lewkowitsch, J., *Chemistry, Technology and Analysis of Oils, Fats and Waxes*, Macmillan, New York, 1921, p. 443.
- Roberts, W. L. and Schuette, H. A., *Ind. Eng. Chem., Anal. Ed.*, 1932, **4**, 257.
- Helrich, K. and Reiman, W., *III Anal. Chem.*, 1947, **19**, 691.
- Rabari, L. F., Patel, R. D. and Chohan, J. G., *J. Amer. Oil Chemists' Soc.*, 1961, **38**, 4.

LETTERS TO THE EDITOR

ENERGY OF A CHARGED PARTICLE

Using Moller's Superpotential

$$U_i^{kl} = \frac{1}{8\pi} \frac{d}{dr} \left[\log \frac{a\sqrt{b}}{|g_{il}|} \right] (\delta_i^k \eta^l - \delta_i^l \eta^k), \quad (1)$$

where

$$\eta^k = \left\{ \frac{x^1}{r}, \frac{x^2}{r}, \frac{x^3}{r}, 0 \right\} \quad (2)$$

for the static metric

$$-ds^2 = a(r)[(dx^1)^2 + (dx^2)^2 + (dx^3)^2] - b(r)dt^2, \quad (3)$$

Shah¹ has shown that the total energy outside the particle of mass m is

$$H = \frac{m^2}{2r} \quad (4)$$

where r , is the radius of the particle.

We now apply the same method to obtain the total energy outside the charged particle of mass m and charge $4\pi\epsilon$. The metric of a charged particle in isotropic co-ordinates is given by^{2,3}

$$-ds^2 = \left(1 + \frac{m}{r} - \frac{a}{r^2}\right)^2 \times [(dx^1)^2 + (dx^2)^2 + (dx^3)^2] - \frac{\left(1 + \frac{a}{r^2}\right)^2}{\left(1 + \frac{m}{r} - \frac{a}{r^2}\right)^2} dt^2, \quad (5)$$

where

$$a = \frac{4\pi\epsilon^2 - m^2}{4}. \quad (6)$$

This gives

$$a = \left(1 + \frac{m}{r} - \frac{a}{r^2}\right)^2, \quad b = \frac{\left(1 + \frac{a}{r^2}\right)^2}{\left(1 + \frac{m}{r} - \frac{a}{r^2}\right)^2}. \quad (7)$$

Using formula (1), the components of U_i^{kl} required for the present study are given by

$$U_4^{4\alpha\beta} = -\frac{(r^2 + a)(mr - 2a)}{r^2 + mr - a} \cdot \frac{x^\beta}{4\pi r^4}, \quad (8)$$

$$\beta = 1, 2, 3. \quad (9)$$

Now the energy momentum complex component

$$\tau_4^4 = U_4^4 \quad (9)$$

becomes

$$\tau_4^4 = -\frac{1}{4\pi r^3} \left[\frac{(r^2 + a)(mr - 2a)}{r^2 + mr - a} \right] \times \left[\frac{2r}{r^2 + a} + \frac{m}{mr - 2a} - \frac{2r + m}{r^2 + mr - a} - \frac{1}{r} \right]. \quad (10)$$

The total energy outside the charged particle

$$E = -\iiint \tau_4^4 dx^1 dx^2 dx^3 \quad (11)$$

becomes

$$E = -\int_0^{2\pi} \int_0^\pi \int_{r_1}^\infty \frac{1}{4\pi r^3} \left[\frac{(r^2 + a)(mr - 2a)}{r^2 + mr - a} \right] \times \left[\frac{2r}{r^2 + a} + \frac{m}{mr - 2a} - \frac{2r + m}{r^2 + mr - a} - \frac{1}{r} \right] r^2 \sin \theta dr d\theta d\phi, \quad (12)$$

$$= -\frac{2a}{r_1} + \frac{(m^2 + 4a)r_1}{r_1^3 + mr_1 - a} \quad (13)$$

where r_1 is the radius of the charged particle.

Equations (6) and (13) give

$$E = \frac{m^2 - 4\pi\epsilon^2}{2r_1} + \frac{4\pi\epsilon^2}{r_1 \left(1 + \frac{m}{r_1} - \frac{a}{r_1^2}\right)}. \quad (14)$$

For $\epsilon = 0$, we get equation (4) as obtained by Shah.

My thanks are due to Prof. R. S. Kushwaha and Dr. P. K. Bhatia for their kind interest in this note.

Dept. of Mathematics,
University of Jodhpur,
Jodhpur, January 7, 1966.

A. L. MEHRA.

1. Shah, K. B., *Curr. Sci.*, 1963, 32, 496.
2. Mehra, A. L., *The Gravitational Field of a Charged Particle in Isotropic Co-ordinates* (to be published).
3. Rosen, N., *Annals of Physics*, 1962, 17, 269.

MOLECULAR AND INTRAMOLECULAR
RELAXATION IN SOME SUBSTITUTED
NAPHTHALENES

RELAXATION times of α -naphthol, β -naphthol, α -amino-naphthalene and β -amino-naphthalene have been determined in the 3 cm. microwave region at a temperature of 20°C., using Gopala Krishna's¹ fixed frequency method for dilute solutions. Standing wave technique of Von-Hippel and Robert's² has been used for the measurements of dielectric constant ϵ' and the loss factor ϵ'' . The free energies of activation

for dipole orientation and viscous flow have been calculated at the same temperature, using Eyring's³ relations and his estimated values of the constants A and B.

All the substances used were of pure quality L. R. grade obtained from B.D.H. Purest quality of benzene obtained from B.D.H. was distilled before use.

The observed values of relaxation time along with the values of free energy of activation are given in Table I.

TABLE I

Values of relaxation time (τ) and free energies of activation for dielectric relaxation and viscous flow

Compounds	$\tau \times 10^{12}$ sec.	H_τ (K. cal./ mole)	H_η (K. cal./ mole)	H_τ/H_η
1. α -Naphthol	8.30	2.29	2.90	1.27
2. β -Naphthol	6.64	2.16	2.90	1.34
3. α -Amino Naphthalene	10.79	2.44	2.90	1.19
4. β -Amino Naphthalene	7.47	2.23	2.90	1.30

The value of the relaxation time of α -naphthol is found to be greater than that of β -naphthol, although the size of the two molecules is the same. The difference in the relaxation time can be explained by considering intramolecular rotation of the -OH group round its bond with the ring. Perhaps the steric hindrance for the rotation of -OH group is greater at the position α than at the position β to the naphthalene ring. Due to similar reasons, the relaxation time of α -amino naphthalene is found to be greater than that of β -amino naphthalene. Further the inner friction experienced by the former molecule may also be greater than that of the latter.

The relaxation times of α - and β -naphthols are found to be smaller than those of α -amino and β -amino naphthalenes respectively. This leads to the conclusion that under similar conditions, -OH group has greater freedom of rotation than -NH₂ group.

The free energies of activation for α - and β -naphthols are found to be smaller than those for α -amino and β -amino naphthalenes respectively. This suggests that the microscopic viscosity experienced by the former molecules may also be smaller than that for latter molecules. Free energies of activation for dielectric relaxation H_τ are always found to be smaller than those for viscous flow H_η . This is in conformity with the results of Franklin and co-workers⁴ that H_τ and H_η are nearly equal only in the case of low viscosity solvent.

The authors express their sincere thanks to Dr. P. N. Sharma for his interest and encouragement.

Physics Department,
Lucknow University,
Lucknow, February 4, 1966.

N. K. MEHROTRA.
M. C. SAXENA.

1. Gopala Krishna, K. V., *Trans. Farad. Soc.*, 1957, **53**, 767.
2. Roberts, S. and Von Hippel, A., *J. Appl. Phys.*, 1946, **17**, 610.
3. Eyring, H., Glasstone, S. and Laidler, K. J., *The Theory of the Rate Process*, McGraw-Hill Co., New York, 1941, p. 548.
4. Franklin, A. D., Heston, W. H., Henely, E. J. and Smyth, C. P., *J. Am. Chem. Soc.*, 1950, **72**, 3447.

PREPARATION OF BROMINE-82 OF HIGH SPECIFIC ACTIVITY

BROMINE-82, an important radioisotope used in industry, medicine and research, is generally produced by the pile irradiation of stable bromides. For certain studies, it is desirable to have a product of high specific activity. The possibility of preparing high specific activity bromine-82 by recoil enrichment has been studied here and a method of preparation is described. Pure para dibromo benzene or disodium phenol tetrabromo phthalein disulphonate is used as target and after irradiation, the Br-82 is separated out by solvent extraction or column chromatography.

(a) The absence of exchange between bromide and *p*-dibromo benzene was confirmed by heating 1 millicurie of bromine-82 as NaBr in dilute sodium sulphite solution with 500 mg. para dibromo benzene in 5 ml. chloroform solution for one hour at 80° C., allowing to cool and counting the phases. It was found that no measurable exchange had taken place.

(b) The absence of exchange between Bromsulfalein and bromide was confirmed by heating an aqueous solution of sodium bromide containing 1 millicurie of bromine-82 with a pH 5-6 aqueous solution of Bromsulfalein for 1 hour at 80-100° C. and separating the Bromsulfalein by column chromatography¹ on alumina. It was found that less than 1% of the bromide had exchanged under these conditions.

(c) 0.5 gm. of pure para dibromo benzene was irradiated in the Canada India Reactor for 1-6 hr. at a neutron flux of $(2-10) \times 10^{12}$ n/cm.²/sec., allowed to cool for 2-3 hr., dissolved in chloroform and extracted with N/50 sodium sulphite solution. The aqueous phase was washed free of the chloroform phase and the recovery estimated by gamma counting. The

total bromide in the extracted sodium bromide solution was estimated colorimetrically² and the specific activity and enrichment factors calculated (Table I).

TABLE I

Sl. No.	Weight of para dibromo benzene irradiated and time of irradiation	Neutron flux $n./cm.^2/sec.$	Percentage recovery of Br-82 as high specific activity	Specific activity of recovered Br-82 mc./gram	Enrichment factor
1	0.5 g. - 30 mins.	5×10^{12}	12	4000	360
2	0.5 g. - 1 hour	5×10^{12}	7	2000	90
3	0.5 g. - 6 hours	2×10^{12}	6	2000	38
4	1 g. - 1 hour	10×10^{12}	9	5000	120

(d) 0.5-1 gm. of Bromsulfalein was irradiated in the Canada India Reactor for 1-6 hr. at a neutron flux of $(2-10) \times 10^{12} n/cm.^2/sec.$, dissolved in dilute (0.1 N) HNO_3 solution and passed down¹ a $6 cm. \times 2 cm.^2$ column of alumina (nitrate form), the column washed with 10 ml. of dilute nitric acid (0.1 N) and the effluent and washings neutralised with sodium hydroxide and passed down a column of cation exchanger Dowex-50 (H^+). The effluent from this column was neutralised and assayed for bromine-82 by gamma counting and total bromide colorimetrically.² The specific activity, percentage of recovery and enrichment factors were calculated. The radiochemical purity of the bromine-82 was confirmed by gamma spectrometry and half-life measurements (for confirming the absence of sodium-24). The absence of phosphorus-32 and sulphur-35 were confirmed by beta assay after the bromine-82 decayed out. The absence of other chemical forms of bromine-82 in the high specific active bromine-82 was confirmed by paper chromatography using butanol acetic acid-water, and 70% aqueous methanol as solvents—Rf of bromide 0.3, 0.7 respectively (Table II).

TABLE II

Sl. No.	Weight of Brom-sulfalein irradiated and time of irradiation	Neutron flux $n./cm.^2/sec.$	Percentage recovery of high specific active Br-82	Specific activity of recovered Br-82 mc./gram	Enrichment factor
1	0.5 g. - 30 mins.	10×10^{12}	45%	5000	240
2	0.5 g. - 1 hour	8×10^{12}	40%	3000	100
3	1 g. - 2 hours	5×10^{12}	40%	2000	60
4	1 g. - 6 hours	2×10^{12}	30%	1000	22

Preparation of Bromine-82.—0.5-1 gm. of para dibromo benzene³ was irradiated at a neutron flux of $(5-10) \times 10^{12} n/cm.^2/sec.$ for

1-6 hr. dissolved in chloroform and extracted with N/10 sodium sulphite solution. The aqueous extract was aerated to remove the last traces of chloroform and adjusted for isotonicity, if required for medical use.

0.5-1 gm. of Bromsulfalein was irradiated, as before, dissolved in water and passed down a column of alumina conditioned in the chloride form and the column washed with water. The effluent and washings were passed down a pencil column ($6 cm. \times 1 cm.^2$) of Dowex-50 (H^+) to remove sodium-24 or distilled with dilute sulphuric acid (~ 10 normal) and the distillate collected in dilute sodium hydroxide solution. A product of specific activity 1-5 curies per gram was obtained with radiochemical purity exceeding 98%.

Isotope Division,
Atomic Energy Establishment,
Trombay, February 18, 1966.

R. S. MANI.

1. Mani, R. S., *Indian Journal of Chemistry* (in press).
2. Cogan, E., *Anal. Chem.*, 1962, **34** (6), 716.
3. Henry R., Aubertin, C. and Valade, J., *Le Journal de Physique et le Radium*, 1958, **19**, 548.

A KINETIC STUDY OF THE BROMINATION OF *p*-BROMOPHENOL IN CARBON TETRACHLORIDE

THE main product of bromination of phenol in dry carbon tetrachloride, *p*-bromophenol, is itself capable of further bromination. Since 1:1 molecular complexes between aromatic compounds and halogens have been shown to exist in carbon tetrachloride,^{1,2} the kinetics of bromination of *p*-bromophenol in carbon tetrachloride solvent has been studied to investigate whether the mechanism is the same as that for the bromination of phenol.

The reaction was carried out in airtight glass-stoppered bottles under the usual thermostatic conditions. It was verified that the reaction is not light sensitive and the reaction was followed by withdrawing 5 ml. aliquots at suitable intervals of time and titrating the halogen remaining unreacted. The reaction product was identified as 2, 4-dibromophenol. No evidence could be found for the presence of 2, 4, 6-tribromophenol.

The overall order of the reaction was found to be 3 by conducting rate measurements with equimolar concentrations of both the reactants in carbon tetrachloride, over the concentration range 0.05 M. to 0.2 M. The individual orders were determined by Ostwald's isolation method. The concentration of *p*-bromophenol

was kept constant at 0.1 M. and that of bromine varied in the range 0.005 M. to 0.01 M. From these results it could be concluded that the order with respect to bromine is one. The order with respect to *p*-bromophenol was found to be two, by keeping the concentration of bromine constant at 0.01 M. and varying that of *p*-bromophenol, the concentration of *p*-bromophenol being always in large excess. These results differ from what has been reported in the case of phenol where the order with respect to bromine is two and that with respect to phenol is one.¹ The bromination of aromatic substrates in carbon tetrachloride, reported so far, have all involved a first order in aromatic substrate and second order or first order in bromine. Our results indicating second order in substrate and first order in bromine appear to be the first of its kind. The temperature coefficient of the reaction is small of the order of 1 k. cal. indicating that in the bromination of *p*-bromophenol too a rapid equilibrium involving the formation of a 1:1 complex between the halogen and the phenol may be present even though the rate determining step might be different.

Department of Chemistry, J. RAJARAM,
Indian Institute of Technology, Madras-36,
February 8, 1966. J. C. KURIACOSE.

1. Vedulaipathi, L. M. and Gnanaprasadam, N. S., *J. Chem. Soc.*, 1956, 4934.
2. Keeler, R. M. and Andrews, L. I., *J. Am. Chem. Soc.*, 1950, 72, 4677.

TWO NEW COMPLEXES OF COPPER (II) FERROCYANIDE WITH ETHYLENEDIAMINE AND PROPYLENEDIAMINE

Co-ordination complexes between copper (II) ferrocyanide ethylenediamine and propylenediamine have been prepared. The general molecular formula turns out to be $[Cu(\text{amine})_2]_2[Fe(CN)_6]$. The visible absorption spectra show a single maximum in the vicinity of 650 mμ.

The complexes were prepared by the following method.

One gm. of powdered copper (II) ferrocyanide was suspended in 10 ml. of acetone. A little more than the calculated quantity of amine was added. The reaction mixture was shaken for 12 hours. The resulting complex was filtered, washed with acetone and dried over phosphoric oxide.

1. $[Cu(H_2NCH_2CH_2NH_2)_2]_2[Fe(CN)_6]$.—The complex is blue violet in colour and soluble in

water, alcohol and formamide. Found: Cu = 22.04%, N = 33.93%, $H_2NCH_2CH_2NH_2$ = 41.08%, $Fe(CN)_6$ = 36.33%, Cond = 238 mhos, visible absorption band = 648 mμ; $C_{14}H_{32}N_{14}Fe$. Cu. requires Cu = 21.94%, N = 33.86%, $H_2NCH_2CH_2NH_2$ = 41.46%, $Fe(CN)_6$ = 36.58%.

2. $[Cu(H_2NCH_2CH_2CH_2NH_2)_2]_2[Fe(CN)_6]$.—The complex is similar to that of the previous complex in general characteristics and solubility. Found Cu = 19.88%, N = 30.68%, $H_2NCH_2CH_2CH_2NH_2$ = 46.4%, $Fe(CN)_6$ = 33.5%, Cond = 250 mhos, visible absorption band = 650 mμ; $C_{18}H_{30}N_{14}Fe$. Cu. requires Cu = 20.07%, N = 30.87%, $H_2NCH_2CH_2CH_2NH_2$ = 46.62%, $Fe(CN)_6$ = 33.36%.

Copper was estimated as salicylaldoxime complex, nitrogen by Kjeldahl method and ferrocyanide was estimated with chloramine-T.¹ The total amine content was estimated as given by the author.² The visible absorption measurements were done in water, on a unicam SP 500 spectrophotometer.

On the basis of percentages of copper, nitrogen, base and ferrocyanide, the molecular formula turns out to be $Cu_2.4$ amine $Fe(CN)_6$. The molar conductance values indicate the complexes dissociating into three ions.³ Thus the general formula for the complexes must be written as $[Cu(\text{amine})_2]_2[Fe(CN)_6]$.

These complexes exhibit a single band in the vicinity of 650 mμ. The crystal field splitting of five 3d levels also requires the occurrence of only one band for planar complexes. In the ground state the positron thus occupies a t_{2g} level from where it is excited by providing energy to a eg level, giving a single band. This band can be associated with $3 t_{2g} \rightarrow 3 e_g$ transition.

Department of Chemistry, GOPAL NARAIN,
Lucknow University,
Lucknow, India, January 20, 1966.

1. Vogel, A. I., *Quant. Inorg. Analysis*, 3rd Ed., ELBS and Longmans, Green & Co. Ltd., 1962, pp. 497, 256, 394.
2. Gopal Narain, *Ind. J. Chem.*, 1966, 44, 895.
3. Emeleus, H. J. and Anderson, J. S., *Advanced Inorganic Chemistry*, 2nd Ed., Routledge & Kegan Paul Ltd., 1952, p. 127.

EXTRACTION OF BLUE PEROXYCHROMIC ACID INTO ION-ASSOCIATION SYSTEMS

The blue peroxychromic acid formed by the addition of hydrogen peroxide to an acidified potassium dichromate solution is very unstable in aqueous solutions but can be stabilized to some extent by the formation of adducts with some donor molecules and the structure then

is suggested as $L \rightarrow CrO_5$, where $L = H_2O$, ether, pyridine, TBP, etc.¹ We have observed that co-ordinating solvents such as tri-*n*-butyl phosphate (TBP), and also ion-association solvents such as tri-*n*-octyl amine, tricaprylyl monomethyl ammonium chloride (ALIUAT-336), tetraphenyl arsonium chloride (Ph_4AsCl), tetraphenyl phosphonium chloride (Ph_4PCl), and cetyl pyridinium chloride (Cet Py Cl), in suitable diluents have not only proved to be good extractants for the blue peroxychromic acid, but also gave appreciably stable extracts so as to enable the photometric determination of chromium.^{2,3}

The ratio of chromium and the extracting anion is found to be 1:1 in all the extracts. The spectra of all the extracts have been recorded with a Hilger-Visispek Spectrophotometer. It is interesting to note that the absorption at 720 $m\mu$ reported in case of TBP-extract is absent in the extracts of the blue peroxychromic acid obtained by extracting with ion-association compounds, although the absorption maximum at 580 $m\mu$ remains unchanged in all the above cases. This shows the existence of different extracted species in the above two types of extraction systems. Also, it is reasonable to expect the formation of an anionic species from the essentially neutral blue peroxychromic acid during its extraction with ion association compounds.^{2,3} Further, it has been noted that the blue peroxychromic acid in aqueous solutions is adsorbed by solid anion-exchange resins like Dowex-1, but not so with their cationic counterparts.

Dwyer and Gibson⁴ have prepared a compound of the blue peroxychromic acid with triphenyl methyl arsonium chloride ($Ph_3MeAsCl$) and assigned the formula of it as $Ph_3MeAsCrO_6$. We have prepared the solid compounds of the blue peroxychromic acid with Ph_4AsCl , Ph_4PCl , and Cet Py Cl. The compounds are fairly stable at room temperatures, and by an analogy of Dwyer and Gibson's compound, we expected the formulæ of these compounds to be Ph_4AsCrO_6 , Ph_4PCrO_6 , and Cet Py CrO_6 , respectively. But surprisingly, these compounds gave test for chlorine and in fact, chromium and chlorine are present in 1:1 ratio in all the above compounds. Hence the formulæ of the above compounds are to be denoted as Ph_4AsCrO_5Cl , Ph_4PCrO_5Cl , and Cet Py CrO_5Cl . The analysis and infra-red evidence are in conformity with the existence of the above anionic chloroperoxy complexes. These facts show the existence of an anionic species of the blue peroxychromic acid such as CrO_5X^- (where

$X = Cl, HSO_4$, etc.) during its extraction by ion-association extraction systems. This incidentally explains the quantitative extraction of the blue peroxychromic acid by tertiary and quaternary amines, which are known to act as extractants by an ion-exchange mechanism.

Our thanks are due to Dr. D. G. Tuck of Nottingham University for his useful suggestions.

Chemistry Department, D. S. SUNDAR.
Andhra University, T. S. R. PRASADA RAO.
Waltair, India, M. N. SASTRI.
February 23, 1966.

1. Tuck, D. G. and Walters, R. M., *Inorg. Chem.*, 1963, **2**, 428.
2. Sastri, M. N. and Sundar, D. S., *Chemist Analyst*, 1961, **50**, 101; *Z. Anal. Chem.*, 1963, **195**, 343; *Anal. Chim. Acta*, 1965, **30**, 340.
3. Sunder, D. S., Thesis submitted to Andhra University, August 1964.
4. Dwyer, F. P. and Gibson, N. A., *Chemistry and Industry*, 1953, p. 193.

EFFECT OF ATROPINE ALONE AND IN COMBINATION WITH TRANQUILLISERS ON MORPHINE-INDUCED ANALGESIA

THE utilisation of preanæsthetic medications in pre-operative surgery is well known. Morphine is used to decrease the anxiety, atropine to reduce bronchial secretions and chlorpromazine to diminish pre-operative apprehension. Chlorpromazine is known to be slightly analgesic^{1,2} and in combination with morphine, it increases the reaction time to obnoxious stimuli. The observation that atropine combined with chlorpromazine showed further prolongation of analgesic reaction time induced by morphine led us to report this communication.

Mice, weighing 18 to 25 gm. and of either sex, of C.D.R.I. colony were used in the experiments. The analgesic reaction time was measured by "Hotplate" technique. A minimum of ten mice were used for each drug, or drug combinations in testing the analgesia. Atropine (1 mg./kg.) and chlorpromazine (8 mg./kg.) were given one hour prior to morphine (15 mg./kg.). A sub-effective dose of morphine (5 mg./kg.) was given to another series of mice alone as well as in combination. All drugs were administered intraperitoneally. Analgesia was measured at every 15 minutes interval after administering morphine. The average analgesic reaction time (sec.) was plotted against time interval (min.) in the graph.

The results of the present investigation shows that the reaction time in mice to morphine-

induced analgesia which have been pretreated with chlorpromazine and atropine together is definitely longer (Fig. 1, Curve 1) than those

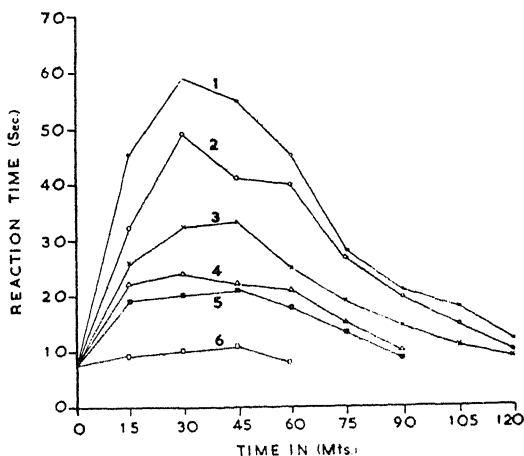


FIG. 1. Curves showing analgesic reaction time. Curve 1. Atropine (1 mg./kg.) + chlorpromazine (8 mg./kg.) + morphine (15 mg./kg.); Curve 2. Chlorpromazine (8 mg./kg.) + morphine (15 mg./kg.); Curve 3. Morphine (15 mg./kg.); Curve 4. Atropine (1 mg./kg.) + morphine (15 mg./kg.); Curve 5. Atropine (1 mg./kg.) + chlorpromazine (8 mg./kg.) + morphine (5 mg./kg.); Curve 6. Chlorpromazine (8 mg./kg.) + morphine (5 mg./kg.).

which were pretreated with chlorpromazine alone (Fig. 1, Curve 2). The same is true for a combination of thioridazine (melleril) and atropine compared to thioridazine alone (unpublished observations). The reaction time of mice to morphine-induced analgesia (Fig. 1, Curve 3) is reduced by pretreatment with atropine sulphate (Fig. 1, Curve 4).

A sub-effective dose of morphine when administered in mice pretreated with chlorpromazine manifests relatively slight activity (Fig. 1, Curve 6) whereas the same dose of morphine increases the reaction time appreciably in mice receiving the combined treatment of atropine and chlorpromazine (Fig. 1, Curve 5).

The results of these experiments may be reconciled if chlorpromazine-induced increase in reaction time to morphine analgesia is directly influenced by atropine within the central nervous system.

Pharmacology Division,
Central Drug Res. Institute,
Lucknow, December 2, 1965.

C. R. PRASAD.
K. KAR.

PAPER CHROMATOGRAPHIC METHOD OF SEPARATION OF ANTIOXIDANTS IN FOODS

THE common antioxidants used in foods are propyl gallate (PG), butylated hydroxy anisole (BHA), butylated hydroxy toluene (BHT) and nor dihydroguaiaric acid (NDGA). A paper chromatographic method for the separation and identification of the above antioxidants is described.

Mitchell¹ has described a two-dimensional paper chromatographic procedure for the separation of four of the antioxidants BHA, BHT, NDGA and PG which is time-consuming. Roy *et al.*² and Dehority³ have described one-dimensional chromatographic techniques using paper impregnated with liquid paraffin and cotton-seed oil respectively as the stationary phase with methanol, ethyl acetate and acetone, ethyl acetate, water as mobile phases respectively.

With these developing solvent systems it was found that NDGA and PG moved too close together to render their detection easy and certain. The replacement of water by 0.1 M sodium acetate solution in the mobile phase was found to help the separation of NDGA and PG. The spraying agents used for showing up the spots on the developed chromatogram depend on the reducing action of the antioxidants on the reagent. Ammoniacal silver nitrate used by Roy *et al.*² is not affected by BHT and therefore could not be used, while ferric ferriocyanide produces a general smudging and spread of colour, phosphomolybdic acid in alcohol has been found satisfactory and has been used in this investigation.

Twenty-five ml of the oil sample containing the antioxidants (0.005%) is shaken vigorously with 15 ml of methanol; the methanol layer is separated, evaporated under reduced pressure and the residue taken up in 0.5 ml ethyl acetate. Whatman No. 1 paper (2.5 × 3.0 mm) is dipped in a 5% solution of refined arachis oil in ether and dried. The solution of the antioxidants in ethyl acetate (0.01 ml) is spotted on the prepared paper about 3 cm. from one end. After drying, the chromatogram is developed with ethyl acetate, acetone and 0.1 M sodium acetate (3:22:75) in a suitable rectangular tank or cylindrical jar by ascending technique for three hours. The paper is then removed, dried in air and sprayed with 10% ethanolic solution of phosphomolybdic acid and exposed to ammonia vapour. The antioxidants

1. Lehmann, H. E. and Hanrahan, G. E., *Arch. neurol. and Psychiatry*, 1954, **71**, 227.
2. Schneider, J. A., *Proc. Soc. exptl. biol. med.*, 1954, **87**, 614.
3. Sadove, M. S., Lenin, J. L., Rose, R. F., Schwartz, L. and White, F. W., *J.A.M.A.*, 1954, **155**, 626.

are revealed as bluish-grey spots with the R_f values as shown in Table I.

TABLE I

Antioxidants			R _f values
BHT	..	..	0.0
BHA	..	..	0.1
NDGA	..	..	0.6
PG	..	..	0.8

These R_f values have been confirmed by tests on individual antioxidants in the same solvent system.

The author is indebted to Sri. K. R. Srinivasan, Govt. Analyst (Retd.), for valuable suggestions and for facilities afforded in carrying out the work, and to Sri. K. Narayanaswami, Govt. Analyst, for kind permission to publish the matter.

Govt. Analyst Labs., S. A. SUBRAMANIAN.
King Institute, Guindy,
Madras-32, February 4, 1966.

1. Mitchell, L. C. *J. Ass. of Agric. Chem.*, 1957, **40**, 909.
2. Roy, B. R., Mitra, S. N. and Sengupta, P. N., *Curr. Sci.*, 1960, **29**, 132.
3. Dehority, B. A., *J. Chromatog.*, 1959, **2**, 384.

SOME BACTERIAL CHARACTERISTICS OF THE COCHIN BACKWATER

As part of the programme on primary productivity of the backwater and the inshore waters around Cochin, investigations on the bacterial flora began from July 1965. The importance of the micro-organisms in the primary productivity of marine and estuarine environments hardly needs any emphasis, for it is well known that the bacterial activity forms an important link in the food chain and the regeneration of nutrients.¹

There is no published information available on the bacterial flora of the Cochin backwater. The only studies on marine bacteria of the Indian waters are from the inshore regions of the Bay of Bengal around Madras and Mandapam.²⁻⁴ The Cochin backwater is a typical estuarine system where due to the inflow of large quantities of freshwater, particularly during the monsoon months, the variations in the salinity from one place to the other and from surface to the bottom are considerable.

Estimations on the bacterial populations were made by using standard techniques of collection and culture.⁵⁻⁶ Water samples were collected

by ZoBell bottles at fortnightly intervals from one station fixed at the channel which leads to the Cochin harbour. The collections were made from three different depths (surface, mid-depth and bottom). Plate counts from these depths showed that the overall bacterial population in the backwater was much higher than those reported from the Bay of Bengal.²⁻⁴ Vertical distribution of the micro-organisms showed a greater density at mid-depth during the monsoon months, when the surface salinity was at its minimum. In the post-monsoon months, the distribution was very different. In some samples, maximum counts were obtained at the surface, whereas in others the maximum counts occurred near the bottom. The reason for such a distribution is not yet clearly understood. However, it seems that there may be some relationship between salinity changes and the abundance of bacteria.

A close examination of the colonies showed a great diversity in form, margin, colour and size. Further tests on the microflora showed that the nature of growth in the sea-water peptone broth was generally good. Practically all the organisms in the sample were actively motile rods. They were predominantly Gram-negative and rarely Gram-positive. Luminescent colonies were quite abundant especially in the surface samples. All these characteristics are typical of marine bacteria.⁷⁻⁸ Nitrate reduction and gelatin liquefaction were very common in almost all the strains. Out of all the strains examined, nearly 70% showed indol production. Tests with carbohydrates (glucose, lactose) showed their strong ability to ferment. Estimations of coliform group by the Most Probable Number method showed a very high density of this group in the backwater. Since the coliform group has been reported to be absent in oceanic waters,⁹ a high degree of abundance of these bacteria signifies considerable pollution of the backwater by the sewage discharge. Out of all the characteristics described above, indol production and the occurrence of coliform group are of special interest with reference to the backwater, as these two characteristics are not of common occurrence amongst the bacteria of purely marine origin. Coliform groups are the disease-producing bacteria commonly found in the human alimentary tract.

These characteristics clearly show that the microflora of the backwater are of a complex nature reflecting the balance of forces of both marine and freshwater. Their role in the

primary productivity, as it is understood now, may be of much greater significance than it was once realised. Further work on this problem is in progress.

I am grateful to Dr. N. K. Panikkar, Director, Indian Ocean Expedition, for his encouragement and for providing all possible facilities of work and to Dr. S. Z. Qasim for his considerable assistance in the work and for his help in the preparation of this paper.

Int. Biol. Programme, N. SANTHAKUMARY.
Indian Ocean Expedition
Directorate, C.S.I.R.,
Ernakulam-1, November 26, 1965.

1. Kriss, A. E., *Marine Microbiology (Deep Sea)*, Oliver & Boyd, Edinburgh and London, 1952.
2. Velankar, N. K., *Proc. Ind. Acad. Sci.*, 1950, **32**, 80.
3. —, *Indian J. Fish.*, 1955, **2**, 96.
4. —, *Ibid.*, 1957, **4**, 208.
5. ZoBell, C. E., *J. Mar. Res.*, 1941, **4**, 173.
6. —, *Bacteriology of the Sea*, McGraw-Hill, New York, 1961.
7. —, *Marine Microbiology*, Chronica Botanica Press, Waltham, Mass., 1946.
8. Wood, E. J. F., *Aust. J. Mar. Freshw. Res.*, 1953, **4**, 160.
9. ZoBell, C. E., *J. Microbiol. Soc., Thailand*, 1961, **5**, 5.

THE DISTRIBUTION OF THE TOTAL ALKALOIDS IN THE DIFFERENT ORGANS OF SOME *DATURA* SPECIES/VARIETIES

In the present text the relative distribution of the total alkaloid in the various parts of the plants of nine *Datura* species and varieties is presented. For this the roots were segregated into root-bark and woody portions, the stems likewise into stem-bark and woody portions, leaves, flowers, capsules and seeds. The location of the alkaloids in the different seed com-

ponents has been reported elsewhere.¹ The various parts of the plants were macerated with a mixture of ether : alcohol (4 : 1) for twelve hours. It was made alkaline with dilute ammonia and shaken frequently for one hour. After filtration through lightly packed cotton-wool and extraction with a minimum quantity of sulphuric acid, the acidified layer was tested with potassium mercuric iodide (Mayer's reagent), iodine potassium iodide (Wagner's reagent) and potassium bismuth iodide (Dragendorff's reagent). For the thin-layer chromatography the solvent system which gave best results was ammonia : chloroform : methanol (1 : 85 : 14). The plates were developed according to the modified Dragendorff reagent (Munier modification).²

Observations.—Alkaloids are present in the seeds, leaves and flowers of all the *Datura* species and varieties investigated. In the capsules and woody portions of the roots no alkaloids were detected in *stramonium* varieties *chalebæya* and *godronii*, *D. tatula* var. *inermis* and in *D. quercifolia*. Alkaloids are present in the root-bark and stem-bark in varying quantities in all the species/varieties studied. In the woody portion of the stems, however, alkaloids are not present in *D. stramonium* var. *chalebæya*, *D. tatula*, *D. quercifolia* and *D. meteloides*. The general pattern of alkaloid distribution as revealed by these investigations (Table I) shows that an abundant amount of alkaloid is present both in the leaves as well as flowers and in the roots and stem barks of *D. innoxia*, *D. stramonium* var. *godronii*, *D. metel*, *D. metel* var. *fastuosa* and *D. meteloides*. In the other species/varieties only meagre to moderate quantities were indicated. Generally the woody portions of the roots and stems had no or only moderate quantity of the alkaloids. It seems that in most species/varieties the alkaloid content diminishes as soon as the fruiting stage

TABLE I
Relative distribution of total alkaloids in different organs of nine *Datura* species/varieties

Species/Varieties	Root		Stem		Leaves	Flowers	Capsules	Seeds
	Bark	Wood	Bark	Wood				
<i>Datura innoxia</i> Mill	.. +++	++	+++	++	+++	+++	+++	+++
„ <i>stramonium</i> var. <i>chalebæya</i>	.. +	—	+	—	+++	++	—	++
„ <i>stramonium</i> var. <i>godronii</i>	.. +++	—	+	+	+++	+++	—	+++
„ <i>metel</i>	.. +++	++	+++	+	+++	+++	++	++
„ <i>metel</i> var. <i>fastuosa</i>	.. +++	++	+++	+	+++	+++	+++	+
„ <i>tatula</i>	.. ++	+	++	—	+++	++	+	+
„ „ var. <i>inermis</i>	.. ++	—	+	+	++	++	—	+
„ <i>quercifolia</i>	.. +	—	+	—	+++	+++	—	+
„ <i>meteloides</i>	.. +++	+++	+++	—	+++	+++	+++	+

+++ Abundant; ++ Moderate; + Small quantity; — Absent.

sets in, the exception being capsules of *D. imoxia*, *D. metel* var. *fastuosa* and *D. meteloides*.

Separation of the extracts of the various fractions by TLC revealed that in all the species/varieties two spots, those of hyosine and hyoscyamine, could be identified with certainty and in some other cases additional spots indicating the occurrence of several other alkaloids were detected.

Regional Res. Laboratory, C. L. MADAN.
(CSIR), Jammu-Tawi, U. S. GUPTA.
(Jammu and Kashmir State), R. K. KHANNA.
January 29, 1966.

1. Madan, C. L., Gupta, U. S., Prabhakar, V. S. and Kapur, B. M., *Die Naturwissenschaften*, 1966, **53**, 109.
2. Munier, R., *Bull. Soc. Chim. Biol.*, 1953, **35**, 1225.

ISOLATION OF *ASPERGILLUS FUMIGATUS* FROM THE CERVICAL MUCUS OF A COW SUFFERING FROM METRITIS

A CASE of *Aspergillus fumigatus* infection in a cow is described here. A Haryana cow suffering from post-parturient metritis was presented for treatment at the college clinics. Cervical mucus was collected and cultures were made to isolate the pathogenic micro-organisms. Two sets of tryptose agar plates were cultured with the mucus each to be incubated in air and in CO₂ tension, at 37° C. for 3 to 7 days. One plate of Sabouraud's glucose agar containing 1:10,000 actidione was also cultured and incubated at room temperature.

No pathogenic organism could be isolated from the tryptose agar plates incubated in air or in CO₂ tension. Some growth was visible on the Sabouraud' medium after about 48 hours and the coverslip preparation revealed mycelial growth and pure cultural characters of the fungi. The characteristic conidiophores were quite suggestive of *A. fumigatus*. The identification of species was later confirmed by the Mycology Laboratory of All-India Institute of Medical Sciences (Mohapatra, L. N., personal communication).

Aspergillosis, though primarily a respiratory disease of birds, has been recorded in almost all domesticated animals and man. It is probable that the most important aspect of mammalian aspergillosis is in connection with mycotic abortions associated with infection of the placenta and perhaps of the lungs (Ainsworth and Austwick, 1959). It is, therefore, suggested that during the course of investigation

of infections of animals related to genital organs, the possible involvement of fungal agents especially *A. fumigatus* should not be lost sight of.

We are grateful to Principal C. V. G. Choudary for the facilities provided and to Dr. Mohapatra for the identification of the species.

Laboratory for Brucellosis R. C. PATHAK.
Research, K. R. MITAL.
U.P. College of Veterinary
Science and Animal Husbandry,
Mathura, January 8, 1966.

1. Ainsworth, G. C. and Austwick, P. K. C., *Vet. Rec.*, 1955, **67**, 88; also *Fungal Diseases of Animals Rec. Series No. 6*, Comm. Bureau of Animal Health C.A.B., England, 1959, 1st Edition.
2. Bendixen, H. C. and Plum, N., *Acta Path., Microbiol. Scand.*, 1929, **6**, 252.
3. Lawson, J. R., Paper presented at 3rd International Congress on Animal Reproduction, Cambridge, 1956.

2-CHLORO-6 (TRICHLOROMETHYL) PYRIDINE* FOR REDUCING NITROGEN LOSSES FROM UPLAND PADDY SOILS

UNDER upland paddy conditions the soil is subjected to alternate well-drained and ponded-water conditions. Ammonium nitrogen supplied to these soils has thus ample opportunity of getting nitrified. Nitrate nitrogen thus formed is easily lost either through leaching or denitrification. Under these conditions the losses of applied nitrogen are likely to be severe and will thus greatly reduce the efficiency of applied nitrogen. The compounds that inhibit or delay the conversion of ammonium to nitrate nitrogen (nitrification) could serve a very useful purpose under these conditions.

Goring reported^{2,3} that 2-Chloro-6 (Trichloromethyl) Pyridine (N-serve) almost completely inhibited nitrification. Several other chemicals such as sodium methyldithiocarbamate,^{4,6,7} di-cyandiamide, sodium azide, zinc ethylenebis-dithiocarbamate^{4,6,7} and mono- and dichlorophenyl isothiocyanates⁵ have also been reported to have such properties. Das¹ in a field experiment on maize found that of the 120 kg. N/ha. applied about 87 kg. N/ha. was lost from the soil (the land was subjected to severe water-logged conditions). The loss was, however, reduced to 50 kg. N/ha. when the fertilizers were applied after treatment with N-serve.

In kharif 1966 a field trial was laid out at the Agronomy Division Farm to study the extent of nitrogen loss under upland paddy conditions when nitrogen was applied in ammonium and

TABLE I
Grain and straw yields, N content of rice crop and nitrogen losses of applied N from the soils

Treatment	Grain yield Q./ha.	Straw yield Q./ha.	N content of crop Kg./ha.	Ammoniacal N + Nitrate N left in soil (0-30 cm.) Kg./ha.	Applied N lost (over control)	
					Kg./ha.	Per cent of applied N
Control	19.1	55.3	34.0	22	No N applied	..
Sodium nitrate	26.7	63.0	52.0	16	58	82.8
Ammonium sulphate	30.2	78.4	56.0	21	48	68.5
Ammonium sulphate treated with N-serve	38.4	92.3	73.0	22	31	44.3
S.E.	2.3	..	..	..	..	..
L.S.D. 0.05	7.8	..	..	..	..	..

* Applied at 70 kg. N/ha.

nitrate forms. Ammonium nitrogen was also applied after treatment with N-serve to investigate the possibilities of reducing the loss of applied nitrogen. Nitrogen was applied in this experiment at 70 kg. N/ha. (40 kg. before transplanting, 20 kg. and 10 kg. top-dressed after 21 and 51 days of transplanting, respectively). N-serve treatment of ammonium sulphate consisted of blending the fertilizer in 1 litre capacity capped bottles with N-serve dissolved in acetone and applied at the rate 2% of nitrogen. Blending was done by shaking with hand for 5 minutes. Experimental design adopted was randomized block with 3 replications and rice variety grown was NP 130. The field where this trial was conducted had a clay-loam soil.

The results obtained are summarised in Table I. Grain and straw yields were maximum in plots receiving ammonium sulphate treated with N-serve and were followed in order by plots receiving ammonium sulphate and sodium nitrate. N-serve treatment gave an increase of 8.2 Q/ha. of rice and 13.9 Q/ha. of straw. The difference due to N-serve treatment was significant with respect to grain yield of rice.

Plant and soil analysis revealed a very interesting picture of the nitrogen economy of the soils under upland paddy conditions subjected to frequent flooding. The losses of applied nitrogen were to the tune of 82.8% and 68.5% for sodium nitrate and ammonium sulphate, respectively. Losses of nitrogen were reduced to 44.3% when ammonium nitrogen was applied after treatment with N-serve. The results reported here suggest that N-serve can be used for minimizing the nitrogen losses from upland paddy soils.

The authors gratefully acknowledge the kind encouragement and guidance by Dr. O. P. Gautam, during the course of this investigation. The sample of N-serve was generously supplied by the Dow Chemical Company, U.S.A.

Division of Agronomy,
I.A.R.I., New Delhi-12,
January 31, 1966.

RAJENDRA PRASAD.
B. B. TURKHEDE.
U. K. DAS.

* Designated as "N-serve," by Dow Chemical Company U.S.A.

1. Das, U. K., "A study on efficiency of utilization of nitrogen from different sources by hybrid maize and losses of nitrogen from soil during growth period of the crop," *Unpublished M.Sc. Thesis*, Division of Agronomy, I.A.R.I., New Delhi, 1965.
2. Goring, C. A. I., *Soil Sci.*, 1962, **93**, 211.
3. —, *Ibid.*, 1962, **93**, 431.
4. Harada, T., *Sci. Rept. Res. Assoc. Univ. (Japan)*, No. 226, 1961.
5. — *et al.*, *J. Sci. Soil and Manure (Japan)*, 1964, **35**, 392.
6. Mitsui *et al.*, *Soil Sci. and Plant Nutrition*, 1964, **10**, 107.
7. Nishihara, T., *Sci. Rept. Kagoshima Univ. (Japan)*, *Fac. of Agric.* No 12, 1962.

CHEMICAL CONSTITUENTS OF ARGEMONE OCHROLEUCA SWART.

In an earlier communication,¹ the lowering of pH of alkaline soils by the addition of the stems and the leaves of *Argemone mexicana* Linn. has been mentioned and the chemical constituents present therein reported. During our use of *A. mexicana* Linn. for the reclamation of Usar land we came across another species of *Argemone*, viz., *A. ochroleuca* Swart. growing sparsely in Uttar Pradesh which is a tetraploid in having 56 chromosomes instead of 28 present in *A. mexicana* Linn. but is different in its morphological characteristics. The present communication deals with the chemical constituents present in the stems and the flowers of *A. ochroleuca* Swart. about which no reference is available in literature. The following compounds have been isolated or identified by chromatography:

Alkaloids.—Berberine nitrate (0.05%) and protopine nitrate (0.05%).

Colouring Matters.—Iso-rhamnetin (0.05%) and its glycoside (0.07%).

Fatty Constituents.—Palmitic, cerotic, oleic and linoleic acids; B-sitosterol and cerev alcohol.

Water-soluble Organic Acids.—Succinic, malic, citric and tartaric acids.

Free Amino-Acids.—Lysine, alanine, proline, valine, serine, phenyl alanine, asparagine, threonine and aspartic acid.

Combined Amino-Acids.—Valine, proline, alanine, glycine, phenyl alanine, asparagine and glutamic acid.

Inorganic Salts.—Potassium nitrate (2.5%) and calcium sulphate (0.6%).

The above results are of interest from chemotaxonomical point of view.

National Botanic Gardens, S. N. SRIVASTAVA.
Lucknow (U.P.), D. S. BHAKUNI.
December 16, 1965. V. N. SHARMA.

1. Misra P. S., Bhakuni, D. S., Sharma, V. N. and Kaul, K. N., *J. Sci. and Ind. Res.*, 1961, 20B, 186.

A NOTE ON THE CYTOTAXONOMY OF *CHLOROPHYTUM LAXUM* R.Br.

Chlorophytum laxum R.Br. belongs to the family Liliaceæ. According to Hooker¹ it is distributed in the Deccan Peninsula in India, Ceylon, Borneo, China, tropical Africa and Australia. It is a grass-like perennial weed. Roots are fleshy and some portions are tuber-like. Shoot emerges out of the soil after monsoon rains. Leaves are distichous and recurved. Scape is flexuous and filiform. Flowers are minute and occur in pairs on the axis of the inflorescence. In each pair one of the flowers is old and the other is young and both are subtended by bracts. Anthers are shorter than filaments. Fruit is a capsule. Flowering starts in May and extends up to August. The entire shoot dies in summer.

The material for the present study was collected from three localities, Hebbal and Cubbon Park, Bangalore and Nandi Hills, Kolar District.

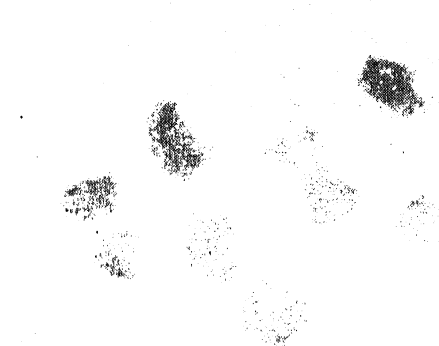
Preparation of temporary slides of mitotic and meiotic stages was as described by Heimburger² and Boraiah and Heimburger.³ Temporary slides were passed through 1:1 *n*-butyl alcohol and acetic acid and then *n*-butyl alcohol and were mounted in euparal.

The chromosome number was found to be 16 (Figs. 1 & 3). The chromosomes are metacentric and near metacentric. No chromosome with secondary constriction was found.

Meiosis was regular. Eight bivalents (Fig. 2) were found in Metaphase I. Neither lagging chromosomes nor bridges and univalents were seen in Anaphase I and II. Micronuclei were absent in pollen tetrads.



1



2

FIGS. 1-2. Fig. 1. Somatic metaphase chromosomes $2n=16$. Fig. 2. Metaphase I with 8_{II}.

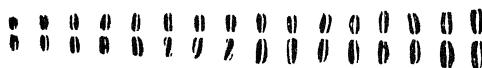


FIG. 3. Drawing of somatic metaphase chromosomes, $\times 700$.

Even though spontaneous inversion in *Chlorophytum elatum*⁴ and reciprocal translocation in somatic chromosomes in *Chlorophytum heynei*⁵ have been reported, such phenomena were not seen in *Chlorophytum laxum*.

Baldwin and Speese⁶ have studied the cytology of the several species of *Chlorophytum*

occurring in Liberia. They have reported a chromosome number of $2n=14$ in *Chlorophytum laxum* and *Chlorophytum inornatum*. However only in the species *Chlorophytum alismifolium* they have reported $2n=16$. In the figure given in their paper for the species *Chlorophytum laxum*, the leaves are not recurved, while in the species *Chlorophytum laxum* collected in these three areas, the leaves are strongly recurved and the description agrees with the description of the species in Hooker's¹ and Gamble's⁷ flora. The material described by Baldwin and Speese as *Chlorophytum laxum* needs clarification.

Grateful acknowledgement is made to Dr. M. Puttarudriah, for providing facilities, to Dr. K. S. Krishna Sastry for his help and encouragement, to the Council of Scientific and Industrial Research, for financial assistance and to Mr. P. R. Raghuram Pillai for his help in photographic work.

Agricultural College (UAS), G. BORAI AH.
Bangalore-24, January 13, 1966.

1. Hooker, J. D., *The Flora of British India*, L. Reeve and Co., 5, Henrietta St., Covent Garden, London. 1872.
2. Heimbürger, M., *Can. J. Botany*, 1959, **39**, 497.
3. Borai AH, G. and Heimbürger, M., *Ibid.*, 1964, **42**, 891.
4. Sheriff, A., *J. Indian Bot. Soc.* 1957, **36** (2), 232.
5. Thomas, K. J., *Cytologia*, 1960, **25**, 97.
6. Baldwin, J. T. and Speese, B. M., *Amer. Jour. Botany*, 1951, **3** (2), 153.
7. Gamble, J. S., *Flora of the Presidency of Madras*, 1957, **8**. Reprinted by the Botanical Survey of India, Calcutta.

FOLIAR VENATION OF SOME SCROPHULARIACEAE

FOSTER,^{2,4} Pray⁶ and Lems⁵ have contributed to our knowledge of venation of leaves of some Angiosperms. In recent studies on *Circeaster*³ and *Kingdonia*¹ Foster used the venation pattern of leaves for the solution of certain taxonomic and phylogenetic problems.

The present study deals with the foliar venation of some members of the Scrophulariaceae with a view to evaluate its role in taxonomy.

The leaves of *Pedicularis megalantha* Don., *P. pectinata* Wall. and *P. carnosus* Wall., *Lindenbergia macrostachya* (Benth.) Benth., *Euphrasia officinalis* Linn. collected from Simla and those of *Antirrhinum orontium* Linn. collected from Meerut; and the leaves of *Deinostema violacea* (Maximov.) Yamazaki obtained from Dr. T. Yamazaki from Japan were used for the present study. These were

cleared by Foster's technique¹ for permanent mounts and stained with safranin in 50% xylol.

The leaves of *Pedicularis* are lobed and each lobe has varying number of lobules. In *P. megalantha* and *P. pectinata*, the number of lobules are more than in *P. carnosus*. The leaves in *Euphrasia* and *Lindenbergia* have serrate and those in *Deinostema* have entire margins.

In the leaf of *Pedicularis*, the veins anastomose at the tips of the lobules and show an accumulation of intramarginal tracheids at the tip. These groups of tracheids assume a hexagonal, pentagonal or rarely quadrangular shape in *P. megalantha*, a cubical or quadrangular shape in *P. pectinata* and a triangular shape in *P. carnosus*. In *P. megalantha*, *P. pectinata* and *P. carnosus* the cubical tracheidal elements extend downwards on the veins for a short distance (Figs. 1-4).

In *Euphrasia* the marginal regions of the serrations show a number of blind vein endings. Each of these latter is expanded at the tip and shows an increase in the amount of tracheids (Figs. 5-6).

In *Lindenbergia macrostachya* at the tip and the marginal teeth of leaves, the veins usually come close to each other, but do not anastomose. The tips of these veins are characterised by the presence of a large number of small 'tracheidal nodules' (Fig. 7).

The leaf of *Antirrhinum orontium* is exceptional among the members of Scrophulariaceae in complete absence of the veins and vein-islets at their apical portion. The primary veins together with vein-islets assume the shape of an arc curving towards the base of the leaf. At the tip of the leaf, the marginal veins usually carry small 'tracheidal nodules' (Fig. 8).

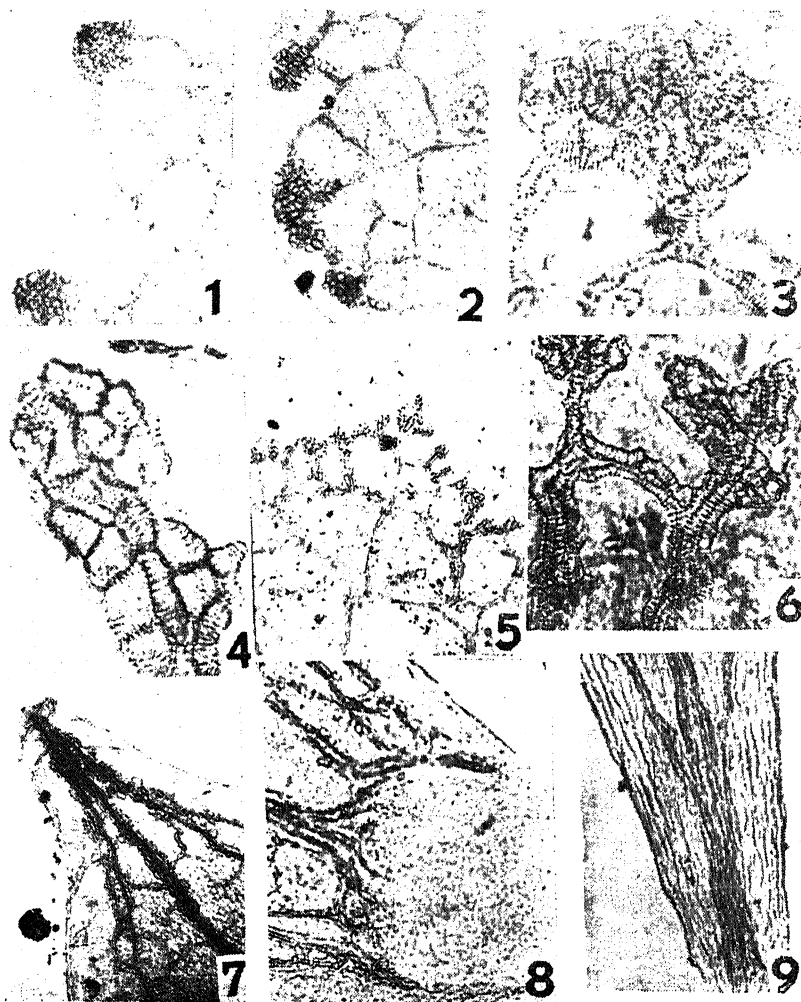
The leaf in *Deinostema violacea* has a simple type of venation. A single trace after entering the leaf from the node divides usually into five primary veins of which the central one forms the midrib. The two outermost laterals, one on either side, disappear after traversing about half the distance of the leaf, while the two others converge to the tip and fuse with the midrib (Fig. 9).

The venation pattern of leaves in *Pedicularis* spp., *Euphrasia officinalis*, *Lindenbergia macrostachya*, *Antirrhinum orontium* and *Deinostema violacea*, is thus quite characteristic and therefore may be considered as an important taxonomic criterion.

All the four species of Euphrasie included in the present study (*Pedicularis megalantha*,

P. pectinata, *P. carnosa* and *Euphrasia officinalis*) are characterised by the accumulation of tracheids either at the tip of the lobules (*Pedicularis*) or at the marginal serrations (*Euphrasia*). It appears that this is a consistent feature in most of the members of the tribe *Euphrasiæ*. But a detailed investigation on the venation in other members of this tribe is necessary to reach any definite conclusion.

So far, the accumulation of intramarginal tracheids are reported in *Anticharis*,⁷ *Pedicularis* and *Euphrasia* only. Varghese,⁷ who noted this phenomenon in the leaf of *Anticharis*, attributed a role of protection, and storage to these structures. However, it is interesting to note that these structures are found only in the leaves of desert plants like *Anticharis* or of plants like *Pedicularis* and *Euphrasia*



FIGS. 1-9. Figs. 1-2. The apical portion of leaves of *Pedicularis megalantha* and *P. carnosa* respectively. Figs. 3-4. Vein endings in the lobules of *Pedicularis carnosa* and *P. pectinata* respectively. Figs. 5-6. Apical portion of the leaf and the marginal vein ending of *Euphrasia officinalis* respectively. Figs. 7-9. Apical portion of the leaves of *Lindenbergia macrostachya*, *Antirrhinum orontium* and *Dioscorea violacea* respectively.

Note the accumulation of tracheids at the vein endings in Figs. 1-6, the 'tracheidal nodules' in Figs. 7-8, absence of veins at the apical portion of leaf in Fig. 8 and fusion of three primary veins at the apical portion in Fig. 9.

Figs. 3, 4 and 6, $\times 250$ and the rest, $\times 60$.

growing in high altitude, where the plants grow in physiologically xerophytic conditions. Therefore it seems that these structural adaptations help the plant to survive in xerophytic environment. The leaves in *Deinostema* are noteworthy for having the simplest type of venation so far known in Scrophulariaceae which may be attributed to its aquatic habit.

The author is thankful to Prof. V. Puri for guidance and valuable suggestions, to Dr. T. Yamazaki for sending the material of *Deinostema*, and to Dr. R. K. Grover for encouragement.

School of Plant Morphology,
Meerut, India, January 25, 1966.

T. M. VARGHESE.*

* Present address: Punjab Agricultural University, Hissar (India).

1. Foster, A. S., *Jour. Arn. Arb.*, 1946 27, 253.
2. —, *Amer. Jour. Bot.*, 1950, 37, 159; 1952, 39, 752.
3. —, *Jour. Arn. Arb.*, 1963, 55, 299.
4. —, *Proc. 10th Internat. Bot. Congr., Abstract.*, Edinburgh, 1964, p. 301.
5. Lems, K., *Bot. Gaz.*, 1964, 125, 178.
6. Pray, T. R., *Amer. Jour. Bot.*, 1954, 41, 663.
7. Varghese, T. M., *Curr. Sci.*, 1963, 32, 423.

STUDIES ON THE ACTIVE CONSTITUENTS OF *CISSUS QUADRANGULARIS*—II

THE plant *Cissus quadrangularis*, Wall. (ver: Harjor), has been found to contain steroidal principles and the preliminary physico-chemical studies of the principle, isolated showed that it had m.p. 134–36° C. and gave positive response to both Leibermann-Burchardt test and Zimmermann test, suggesting the presence of OH group and CO group in the steroidal nucleus. The UV and IR studies of the principle, as reported earlier,¹ indicated the presence of 4:5, 6:7 unsaturation with at least three chromophore groups C=O, C=C and C≡C together with exocyclic double bond and conjugated chain.

The crude steroidal principle, thus obtained, on chromatographic analysis showed the presence of two distinctly separate constituents, with very close R_f values. 1.5 grams of the crude steroidal principle was then rechromatographed, using Alumina (Brockmann) as adsorbent and the principles I and II were obtained from petroleum ether and ether solvent elutes respectively. While the principle I (m.p. 249°–52° C.), responded to Zimmermann test, the principle II (m.p. 136°–138° C.), failed to give any response to this test. The IR studies

undertaken with the two principles showed that principle I has an absorption band at 5.85 μ, indicating the presence of Ketonic group, and thus confirming that it is a Ketosteroid.

The micro-chemical analysis of the two principles gave the following results:

Principle I—C₂₇H₄₅O (Calc.: C—84.06% ; H—11.77%). Mol. wt. —463, [α]₂₀^D = —17.7.

Principle II—C₂₃H₄₁O (Calc.: C—82.95% ; H—12.18%). Mol. wt. —333, [α]₂₀^D = —25.92.

The author is grateful to the Director, National Chemical Laboratory, Poona, for undertaking the infra-red studies of the principles and to Dr. G. Weiler, Oxford, for the micro-analytical studies.

Department of Medicinal
Chemistry,

S. P. SEN.

College of Medical Sciences,
B.H.U., February 17, 1966.

1. Sen, S. P., "Study of active constituents (Ketosteroid) of *Cissus quadrangularis*," *Ind. J. Pharm.*, 1964, 26, 247.

SOME OBSERVATIONS ON THE LAMETA SERIES OF MADHYA PRADESH

THE Lameta series consisting of limestones, sandstones, shales and clays occurs as discontinuous outcrops in different parts of Madhya Pradesh and Gujarat. They have been considered to be of fluvial² or estuarine origin.¹ Regarding their relationship with the underlying Bagh beds, Blanford³ was of the opinion that the Lametas pass conformably into the marine Bagh beds, whereas Bose⁴ maintained that the passage was always an unconformable one. As regards their relationship with the underlying Jabalpur stage exposed near Jabalpur, Matley⁵ observed that the contact is a conformable one. In a more recent paper Roy Chowdhry and Sastry⁶ observed that "the Lametas exposed between Chirakhan and Jalakhan lie conformably over the Coralline limestone". This has been confirmed by the present writer while doing field-work near Bariah village, 2 miles north of Avalda, Man Valley, where the following sequence is exposed:

Deccan Traps

Lameta clays 2 ft. thick

Coralline limestone....(Bagh beds) 10 ft. thick

The Lameta clays contain numerous well-preserved shells of *Ostrea* spp. (Fig. 1) and microscopic remains of the foraminiferal genus

reported from various outcrops of the indicate the return of freshwater in the area.

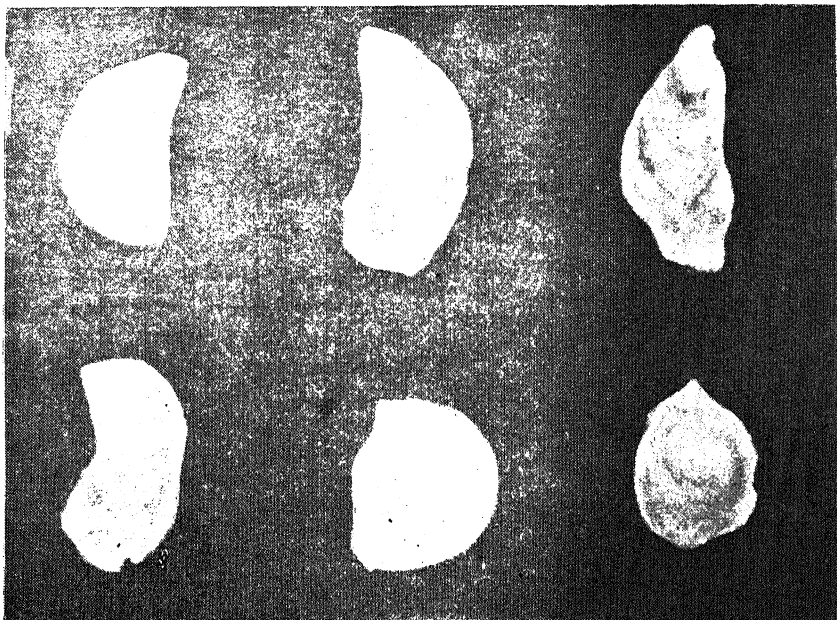


FIG. 1. *Ostrea* spp., $\times 1$.

Ammobaculites. The presence of these in the basal part of the Lameta sequence indicates deposition in shallow marine (Littoral) or brackish waters. Absence of unconformity indicates a gradual passage of the Bagh beds up into the Lametas in this area and suggests that they form part of one continuous cycle of sedimentation. The marine transgression in the area started at the end of the Nimar sandstone (fluvatile) as evidenced by the presence of a thin oyster bed at the base of Nodular limestone. Shallow-marine to brackish conditions existed during the Nodular limestone time as is indicated by the presence in large number of *Ammobaculites* spp. and other brackish-water forms while open-sea conditions prevailed during the deposition of Coralline limestone as is indicated by the presence of *Globigerina*, etc.⁷ The oyster-bearing clay at the base of the Lametas marks the regressional phase of the Cretaceous transgression. Large number of fish, reptilian and freshwater mollusc remains

The view presented in the paper is in conformity with Nagappa's⁸ observations "the existence of definite cycles of transgression and regression" during the Cretaceous, Tertiary and Eocene.

The author is grateful to Prof. P. R. Rao and Dr. S. B. Bhatia for the help during the course of present work.

Geology Department, S. I.
Panjab University,
Chandigarh-3, December 27, 1965.

1. Krishnan, M. S., *Geology of India and Burma*, p. 480.
2. Pascoe, E. H., *A Manual of Geology of Burma*, 1963, p. 1349.
3. Blanford, W. T., *Mem. Geol. Surv. India*, 1863, 6 (3).
4. Bose, P. N., *Ibid.*, 1884, 21 (1).
5. Matley, C. A., *Rec. Geol. Surv. Ind.*, 1903, 19.
6. Roy Chowdhry, M. K. and Sastry, V., *and Cult.*, 1954, 20 (4).
7. Jain, S. P., Unpublished Ph.D. thesis, 1959.
8. Nagappa, Y., *Micropalaeontology*, 1959, 5.

REVIEWS AND NOTICES OF BOOKS

Chemical Aspects of the Autonomic Nervous System. By D. J. Triggle. (Academic Press, London and New York), 1965. Pp. ix + 329. Price 75 sh.

Effective progress towards the successful elucidation of receptor structure and function will require the application of physico-chemical techniques and theories and this book represents an attempt to indicate some of the more important problems that have to be solved in this field. Essentially a discussion of peripheral cholinergic and adrenergic transmission processes, it will inform the biologist and chemist of each others' problems and perhaps lead to a more profitable collaboration with an ultimately successful attack on the problem of receptor structure and function.

The titles of the chapters contained in this volume are as follows: The Structure and Function of the Nervous System; The Properties of Excitable Tissue; The Chemical Mediation of Synaptic Transmission; The Analysis of Drug-Receptor Interactions; Cholinergic Mechanisms: The Presynaptic Site of Action; Cholinergic Mechanisms: The Postsynaptic Site of Action, Acetylcholine and Related Compounds; Cholinergic Mechanisms: General Considerations of Acetylcholine Antagonists; Cholinergic Mechanisms: Blockade of Postganglionic Parasympathetic Synapses; Cholinergic Mechanisms: Blockade at Ganglionic Synapses; Cholinergic Mechanisms: Blockade at Neuromuscular Junctions; Cholinergic Mechanisms: The Inhibition of the Synthesis of Acetylcholine; The Cholinergic Receptor; Adrenergic Mechanisms: The Cholinergic Site of Action; Adrenergic Mechanisms: The Structure-activity Relationship of Sympathomimetic Amines; Adrenergic Mechanisms: The Uptake, Storage and Release of Noradrenaline; Adrenergic Mechanisms: Agents which Affect the Uptake, Storage and Release of Noradrenaline; Adrenergic Mechanisms: Reversible Antagonists at the Adrenergic Receptor; Adrenergic Mechanisms: Irreversible Antagonists at the Adrenergic Receptor; Adrenergic Mechanisms: Biosynthesis and Inhibition of Synthesis of Catecholamines; Adrenergic Mechanisms: The Metabolism and Metabolic Inhibitors of Catecholamines; The Adrenergic Receptor; The Structure and Function of the

Pharmacological Receptor—General Considerations.
C. V. R.

Catalytic Hydrogenation—Techniques and Applications in Organic Synthesis, by Robert L. Augustine. (Marcel Dekker, Inc., 95 Madison Avenue, New York), 1965. Pp. xii + 188. Price \$ 8.75.

This monograph provides an authoritative review of the vast literature pertaining to catalytic hydrogenation. By using this book, graduate students, technicians, and experienced workers in organic synthesis will save considerable time and effort in determining the proper conditions for a catalytic hydrogenation. The literature has been examined for as many catalytic-hydrogenation reactions with possible synthetic applications as could be found. Particular attention has been paid to those reactions that are selective in either a stereochemical or reactive sense.

The book presents a discussion: (1) different types of apparatus as well as operating instructions for the more common pieces of equipment, (2) catalysts, the effect of variables such as temperature and pressure on the outcome of hydrogenation, and the preparation of the common catalysts, and (3) general procedures for the hydrogenation and hydrogenolysis of functional groups. This text is designed to be used independently of other reference sources for almost all hydrogenation applications.

C. V. R.

Transition Metal Chemistry—A Series of Advances (Vol. 1). Edited by Richard L. Carlin. (Marcel Dekker, Inc., New York), 1966. Pp. xi + 307. Price \$ 12.75.

This series is devoted to the science of the transition elements, and is geared to research scientists, graduate students, and teachers of advanced inorganic chemistry. As transition metal chemistry is one of the oldest and largest areas of research in inorganic chemistry, the many facets of its progress will be surveyed regularly, attention being paid to both theoretical and experimental aspects, as well as the borderline areas. New subjects of transition metal physics and transition metal biology will also be reviewed as it is here that some of the more important future discoveries will be made.

The editor has been able to secure the cooperation of outstanding scientists in this field, whose contributions will be up-to-date reviews of subjects of the highest current interest.

The contents of Volume 1 are as follows: Electronic Structure and Stereochemistry of Cobalt (II), by Richard L. Carlin; Aqueous Chemistry of Chromium (III), by Joseph E. Earley and Roderick D. Cannon; Hydride Complexes of the Transition Metals, by Alvin P. Ginsberg; Electronic Structures of Square Planar Metal Complexes, by Harry B. Gray.

C. V. R.

Nonexistent Compounds—Compounds of Low Stability. By W. E. Dasent. (Marcel Dekker, Inc., New York), 1965. Pp. ix + 182. Price \$ 8.50.

This book covers the field of compounds whose structures do not offend the simpler rules of valence, but which, nevertheless, are characterized by a low degree of stability. It enables the inorganic, metal-organic, and organic chemist to determine whether the formation of a "missing" compound is precluded by thermodynamic circumstances, or whether that compound could be prepared by the appropriate choice of reaction path and reaction conditions.

The titles of the chapters contained in this book are given below: General Considerations; Compounds whose Instability is a Consequence of the Restriction of First-Row Atoms (Li to F) to a Valence Octet; Compounds whose Instability is Related to the Reluctance of Certain Atoms to Under Self-Linkage or Catenation; Compounds whose Instability is a Consequence of the Reluctance of Atoms of the Second (and Subsequent) Rows to Form Multiple Bonds Involving $p\pi$ - $p\pi$ Overlap; Compounds whose Instability has been Attributed to the Operation of an "Inert Pair" Effect; Compounds of Elements of the First Long Period whose Highest Oxidation State is Relatively Unstable; Some Compounds of the Noble Gases; Miscellaneous Compounds.

C. V. R.

Chemical Oceanography (Vol. II). Edited by J. P. Riley and G. Skirrow. (Academic Press, London and New York), 1965. Pp. xv + 508. Price 115 sh.

This treatise is intended primarily for advanced students and research workers in chemical oceanography, and it gives a comprehensive, authoritative and up-to-date account

of the subject in its widest sense. It embraces not only sea-water chemistry as such but also gives consideration to the interaction of sea-water with marine sediments and to the chemical factors controlling marine productivity. Each chapter has been contributed by a special author and the work has been so designed to be useful to workers in related fields such as marine biology and geology.

The list of the titles of the chapters contained in this volume are as follows: Geologic Conditions of Sedimentation, by Ph. H. Kuene; Elemental Geochemistry of Marine Sediments, by R. Chester; Some Aspects of the Geochemistry of Marine Sediments, by Karl Turekian; Carbonate Precipitation and Dissolution in the Marine Environment, by Prest E. Cloud, Jr.; Formation of Marine Sediments, by H. Borchert; Principles of Oceanic Salt Deposition and Metamorphism, by H. Borchert; The Geochemical History of the Oceans, by G. D. Nicholls; Analytical Chemistry of Sea-Water, by J. P. Riley; Radioactive Nuclides in Sea-Water, Marine Sediments and Marine Organisms, by J. D. Burton.

C. V. R.

Advances in Chemotherapy (Vol. 2). Edited by A. Goldin, F. Hawking and R. Schnitz. (Academic Press, New York and London), 1965. Pp. x + 330. Price \$ 13.00.

Volume 2 of *Advances in Chemotherapy* offers its readers a cross-section of recent developments and theoretical aspects in the fields of experimental and applied chemotherapy. Authoritative articles have been contributed by experienced investigators working in individual areas.

The field of cancer research is presented in studies on the olivomycin group of structurally related antibiotics. The therapeutic application of chemical antimalignancy is described in an extensive analysis of the treatment schedules for leukemia in humans. The biochemical elucidation of biological action in the purine and pyrimidine group covers a wide field of chemotherapy. Antibacterial chemotherapy is discussed in a chapter covering the chemical, biological and anti-infectious properties of the cephalosporins. This important field is also covered in an article on tuberculosis therapy and its organization in developing countries. Problems of anthelmintic action form the contents of a contribution on plant nematodes.

C. V. R.

Advances in Applied Microbiology (Vol. 7).

Edited by W. W. Umbreit. (Academic Press Inc., New York and London), 1965. Pp. xi + 403. Price \$14.00.

The scope of this volume is indicated by the titles of the chapters and their respective authors given below: Microbial Carotenogenesis, by Alex Ciegler; Biodegradation: Problems of Molecular Recalcitrance and Microbial Fallibility, by M. Alexander; Cold Sterilization Techniques, by John B. Opfell and Curtis E. Miller; Microbial Production of Metal-Organic Compounds and Complexes, by D. Perlman; Development of Coding Schemes for Microbial Taxonomy, by S. T. Cowan; Effects of Microbes on Germfree Animals, by Thomas D. Luckey; Uses and Products of Yeasts and Yeastlike Fungi, by Walter J. Nickerson and Robert G. Brown; Microbial Amylases, by Walter W. Windish and Nagesh S. Mhatre; The Microbiology of Freeze-Dried Foods, by Gerald J. Silverman and Samuel A. Goldblith; Low-Temperature Microbiology, by Judith Farrell and A. H. Rose. C. V. R.

Advances in Marine Biology (Vol. 3). Edited by Sir Frederick S. Russell. (Academic Press, London and New York), 1965. Pp. x + 402. Price 84 sh.

The very great expansion of marine research in recent years has resulted in a mass of published results scattered through a very wide range of periodicals. In consequence it is becoming increasingly difficult to obtain a general picture of the overall advance that is being made in our knowledge of the many aspects of life in the sea. This series is designed to contain comprehensive review articles summarizing the general position of our knowledge in individual fields.

The present volume under review includes review articles on the effects of heated effluents upon marine and estuarine organisms, learning by marine invertebrates, aspects of the biology of seaweed of economic importance, and marine toxins and venomous and poisonous marine animals. C. V. R.

Advances in Space Science and Technology (Vol. 7). Edited by F. I. Ordway. (Academic Press), III. 1965. Pp. 460. Price \$15.00.

The volume opens with the second part of the article "Progress in Rocket, Missile, and Space Carrier Vehicle Testing, Launching, and Tracking Technology" the first part of which

appeared in Volume 6 (*Curr. Sci.*, 1965, 34, 444). Whereas the first part surveyed the major facilities in the United States, the second part surveys the facilities located elsewhere in the world. The second article is on "Lunar Resources" by John Bensch and R. Q. Shotts. As the nearest astronomical objective, the Moon will be the first stepping-stone in man's space conquest. To establish himself on the Moon, man will have to discover and exploit indigenous resources and construct bases on the Moon. These aspects of the problem are dealt with in this chapter and the two following chapters on "Base Construction on other Worlds" by G. Dileonardo and R. W. Johnson, and "Organization and Management of Space Programs" by F. E. Kast and J. E. Rosenzweig. The last three chapters are respectively on "Establishing an Operational Weather Satellite System" by J. G. Vaeth; "Astronautical Investigations of Comets" by P. Swings; and "Some Aspects of the Physics of Interplanetary Space Related to Out-of-the-Ecliptic Studies" by L. Brermann. A. S. G.

Introduction to Space Science. Editor W. N. Hess. (Written by the Staff of the Goddard Space Flight Center, NASA. Gordon and Breach, Science Publishers, 150, Fifth Avenue, New York), 1965. Pp. 934. Price: Professional Edition \$10; Reference Edition \$21.75.

Results of satellite investigations have enlarged our understanding of space and opened up new horizons of research concerned with space. This unique volume provides fundamental information on various aspects of space science and the book will appeal to every intelligent reader interested in the exciting developments taking place in this field of activity.

Space science includes a variety of topics. It includes astronomy both optical and radio, cosmic-ray studies, and atmospheric and ionospheric physics. It includes plasma physics with regimes in density and temperature not easily reproduced in the laboratory. It includes geomagnetic field, charged particles and aurora. It includes the study of the moon and the planets and their atmospheres. It includes stellar evolution and cosmology. All these topics are dealt with in this book written by specialists in each field attached to the Goddard Space Flight Center, National Aeronautics and Space Administration, U.S.A. Each subject is introduced historically leading up to a statement of current research problems.

The contents include: I. *The Earth and its Environment* dealing with the shape of the

earth, earth's magnetism and magnetic field, atmosphere, ionosphere, radiation belt, aurora, and space meteorology. II. *Space* with chapters on interplanetary medium, magnetosphere, cosmic rays, cosmic chemistry, orbital mechanics, and man in space. III. *The Solar System and Beyond* with chapters on origin of the solar system, the sun, the moon, planetary structure, planetary atmosphere, space astronomy, stellar evolution, radio astronomy, and nucleosynthesis and origin of elements. Among the contributors are A. G. W. Cameron, R. C. Cameron, R. Jastrow, T. N. Davis, W. N. Hess, J. Rosenberg, etc.

The book includes a large number of figures and pictures which will enable even a lay reader to understand in a general way the scientific treatment of the fundamentals of the principal phenomena dealt with in the text. The specially brought out professional edition at a low cost should encourage interested individuals to own a copy. A. S. G.

Essential Chemistry (Vol. I). By K. A. Hassall and C. H. Dobinson. (Iliffe Books Ltd., Dorset House, Stamford Street, London S.E. 1), 1965. Pp. 299. Price 18 sh. (Paper-bound).

The two-volume publication *Essential Chemistry*, written by two experienced teachers, is intended to give a modern approach to the teaching of chemistry in schools and technical institutions. Basic ideas of atomic structure, electrochemical series, principles of valency, and oxidation reduction systems are clearly explained and followed throughout in the treatment. Emphasis is laid on learning by experiments, and much space has been devoted to practical experiments and demonstrations made easy by illustrations of apparatus. The authors have taken into account prescribed syllabuses for various examinations at secondary school levels. A. S. G.

Principles of Physics. By F. Bueche. (McGraw-Hill Book Company, International Division, New York), 1965. Pp. 660.

The book has been specially written to suit the requirements of the precalculus course in general physics in American Universities. Much of the usual descriptive portions has been removed, and instead, principles and their appli-

cations find emphasis. Illustrations are profuse. The author believes in learning physics through working problems. A large number of problems have been worked out in the text, and a larger number of questions and problems included at the end of each chapter. A special feature is that a relatively large number of pages have been devoted to modern physics. A. S. G.

Books Received

Theory of Elasticity. By M. Filonenko-Borodich. (Dover Publications, New York), 1965. Pp. 378. Price \$1.75.

Collection of Problems in Theoretical Mechanics. By I. V. Meshchersky. (Dover Publications, New York), 1965. Pp. 301. Price \$1.50.

Crustaceans. By W. L. Schmitt. (Ann Arbor Science Paper Backs; The University of Michigan Press), 1965. Pp. 204. Price \$1.95.

Dictionary of Economic Plants in India. By P. Maheshwari. (Indian Council of Agricultural Research, New Delhi), 1965. Pp. 197. Price Rs. 9-50.

A Bibliography of Indology (Vol. 2) (Indian Botany), Part II, K-Z. By V. Narayanaswami. (The Librarian, National Library, Calcutta), 1965. Pp. xxx + 412. Price Rs. 8-25.

Applied Bessel Functions. By F. E. Relton. (Dover Publications, New York), 1965. Pp. vi + 191. Price \$1.85.

The Structure of Atoms and Molecules. By V. Kondratyev. (Dover Publications, New York 10014), Pp. 530. Price \$2.50.

The Protection of Transmission Systems Against Lightning. By W. W. Lewis. (Dover Publications, New York 10014), 1965. Pp. xiii + 422. Price \$2.75.

Annual Review of Entomology (Vol. 11). By R. F. Smith and T. E. Mittler. (Annual Reviews Inc., 231, Grant Avenue, Palo Alto, California), 1966. Pp. vii + 596. Price \$9.00.

Relativity and the New Energy Mechanics. By J. Mandelker. (Philosophical Library, Inc., 15, East 40th Street, New York), 1966. Pp. xii + 84. Price \$4.00.

Documents on Modern Physics—Neutrino Astrophysics. By Hong-Yee Chiu. (Gordon and Breach, 150, Fifth Avenue, New York City), 1966. Pp. 115. Price \$5.00; Paper \$2.50.

Structure and Evolution of the Stars. By M. Schwarzschild. (Dover Publications, New York-14), 1965. Pp. xvii + 296. Price \$2.25.

CHEMISTRY OF PHENYL OSAZONES AND A STUDY OF CHELATION

A. C. JAIN AND T. R. SESHADRI

Department of Chemistry, University of Delhi, Delhi-7

PHENYL HYDRAZINE was discovered by Emil Fischer in 1875. Though its reaction with a few carbonyl compounds like acetaldehyde, benzaldehyde and furfural were first noted, its general utility for giving sparingly soluble and beautifully crystalline derivatives of carbonyl compounds in general and the reducing sugars in particular came eight years later. Reaction with reducing sugars proceeded in an unexpected manner, since Fischer^{1,2} found that 3 equivalents of the reagent were consumed. The crystalline products which he called osazones can be identified both from their temperature of decomposition and from their crystalline structures. Hence Fischer made an extensive application of these derivatives for the characterisation, isolation and study of the configuration of sugars which though crystalline singly show tendency to remain as syrup in mixtures. However, both the structure and the mechanism of the formation of osazones, explained to some extent by Fischer 80 years ago, have been clarified only recently.

Fischer^{1,2} suggested the open chain structure (Chart I) for the phenyl osazone of glucose and it was accepted for a long time because it satisfactorily explained how D-glucose, D-mannose and D-fructose gave the same osazone. But a number of facts remained unexplained on the basis of this structure. For example, it was not clear why the reaction stops at the second carbon atom and does not continue further. Fieser and Fieser,³ on purely theoretical grounds, first suggested two alternate chelate structures (II) and (IV) for sugar phenyl osazones, these being stabilised by resonance with the canonical forms (III) and (V) respectively. Since then, these structures have been supported by physical as well as chemical methods. Very recently, n.m.r. spectral studies have further distinguished among the various chelate structures and favoured the structures II and (III) are the limiting forms of a quasiaromatic structure (VI). This is supported by the results of X-ray analysis,⁶ which show that the 6-membered chelate ring is approximately planar and that its bond angles are about 120°. This formulation satisfactorily explains all the

following characteristic properties of the phenyl osazones. (1) Reaction with phenyl hydrazine stops at the C₂ atom but that with N-methyl phenyl hydrazine continues further and all the carbon atoms in the sugar are affected giving

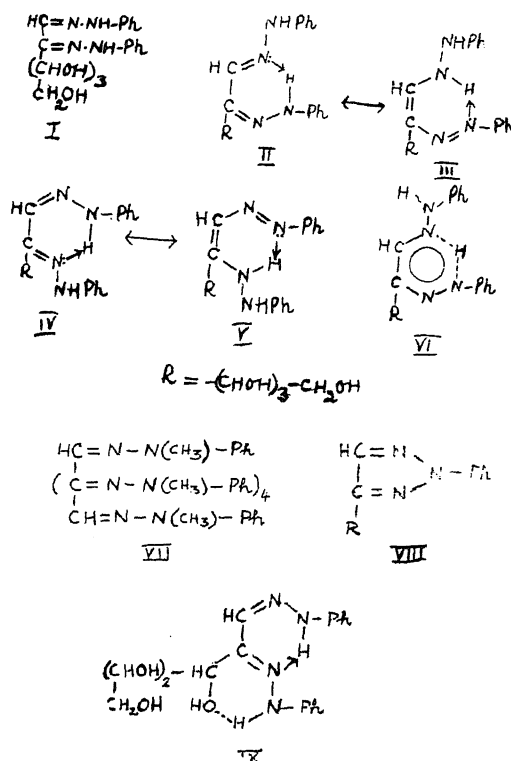


CHART I

alkazones (VII)⁷ in which no chelation is possible. (2) The two phenyl hydrazone residues differ in their behaviour towards methylation, reduction, *trans* osazonisation, formation of osone hydrazone and osotriazole (VIII). (3) Phenyl osazones are formed not only by reducing sugars but also by other α -hydroxy carbonyl compounds. For example benzoin and fisetol form phenyl osazones. (4) Phenyl osazones of sugars differ from those of non-sugars like benzoin and glyoxal. There is no convincing explanation so far for the difference. But there is no doubt that it is due to the presence of a 3-hydroxy group in sugar osazones. From the u.v. data on model

compounds, Henseke and Binte⁸ inferred the presence of an additional C-O...H-N bond in sugar osazones and preferred formulæ (IV & V) which are capable of showing additional chelation as in (IX). But this does not agree with the conclusions of n.m.r. data. Obviously, there is a need for a closer study of this problem.

The mechanism of osazone formation from α -hydroxy carbonyl compounds has been difficult to understand. It apparently involves oxidation of an α -ketol system. Further it uses three moles of phenyl hydrazine and gives aniline and ammonia as the other products. The first stage is definitely the formation of phenyl hydrazone (Chart II, X) from one mole each of the phenyl hydrazone and the α -hydroxycarbonyl compound.⁹⁻¹⁰ The further conversion into phenyl osazone has been pictured in a number of ways. According to Fischer²⁻⁹ the second molecule of phenyl hydrazine produced dehydrogenation to α -keto phenyl hydrazone (XI) itself decomposing into aniline and ammonia, and then the third molecule of the reagent condensed to give the osazone. Thus it visualised the intermolecular oxidation brought about by phenyl hydrazine which is ordinarily a reducing agent. In 1940, Weygand¹¹ proposed two other mechanisms (Scheme A and Scheme B) involving intramolecular oxidation and reduction and thus eliminated the above objectionable feature. According to Scheme A, the phenyl hydrazone (X) tautomerises to enamine (XII) which tends to undergo rupture of the N-N bond because of the stability of the resulting conjugated keto imine (XIII). The ketoimine subsequently takes up two molecules of phenyl hydrazine to give the phenyl osazone (I). In Scheme B, the phenyl hydrazone (X) suffers internal dehydrogenation and hydrogenation.

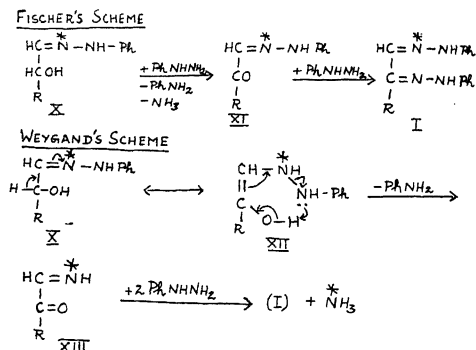


CHART II

In recent years, Weygand *et al.*¹²⁻¹⁵ have studied this reaction with the aid of deuterium

and tritium labels and concluded that both the mechanisms proceed simultaneously. But his experiments were not free from exchange reactions. More recently, Shemyakin *et al.*¹⁶ have convincingly proved by using ¹⁵N labels and avoiding exchange reactions that only mechanism A operates. Thus when *p*-nitrophenyl hydrazones of benzoin, cyclohexanolone and D-fructose having ¹⁵N bound to C₁ were converted into osazones with ordinary phenyl hydrazine, most of the ¹⁵N appeared in ammonia. This is possible only in Scheme A; in Fischer's scheme, ammonia should not be radioactive at all whereas according to Weygand's Scheme B, it should be only 50%. Further, the intermediate ketoimine, expected for Scheme A, has been isolated in the case of cyclohexanolone *p*-nitrophenyl hydrazone (XIV) in the form of the N-acyl derivative (XV) and it gives the osazone in a high yield with excess of *p*-nitrophenyl hydrazine in dilute acidic solution.

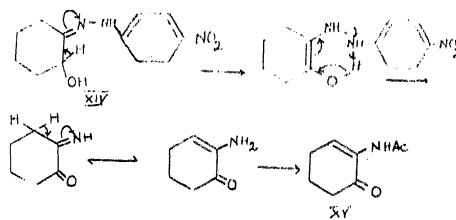


CHART III

A rather complex mechanism was suggested by Micheel and Dijong¹⁷⁻¹⁸ who claimed to have proved with the aid of ¹⁴C phenyl hydrazine that oxido-reduction is not an intramolecular reaction. According to them the reaction is initiated by the decomposition of a little amount of phenyl hydrazine into aniline, ammonia, benzene and nitrogen; but convincing data are lacking. Further, Shemyakin *et al.*¹⁶ noted no decomposition in their carefully planned experiments. Hence the most acceptable mechanism is provided by Weygand's Scheme A.

ω -Hydroxyacetophenones possessing an α -ketol system also form phenyl osazones just like reducing sugars and benzoin. The first case studied was ω , 4-trihydroxyacetophenone by Leon *et al.*¹⁹ and a later one was ω -2, 4-trihydroxyacetophenone by Charlesworth *et al.*²⁰ More recently this property has been used by us²¹ in distinguishing between flavones and flavonols (see Chart IV). The ketone resulting from the fission of the fully methylated flavone (a) or flavonol (d) is demethylated with hydrobromic acid. In the case of flavonol, ω -hydroxyacetophenone (c) would result which yields phenyl osazone (f)

but flavone (a) yields acetophenone (b) which forms phenyl hydrazone (c) only.

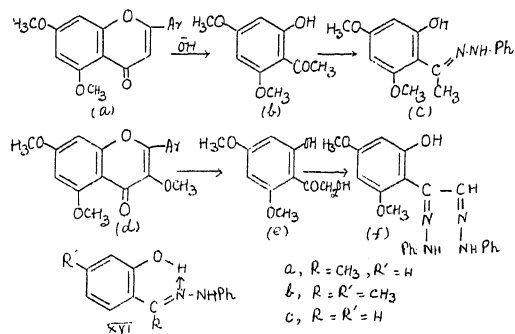


CHART IV

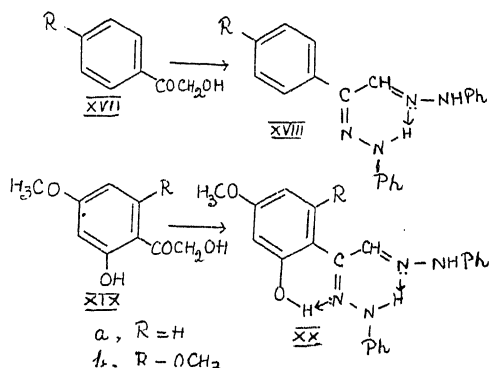


CHART V

Phenyl osazones of *o*-hydroxyacetophenones are interesting from another point of view. When *o*-hydroxy group is present, it could further stabilise the quasiaromatic osazone ring by additional chelation (see Chart V, XX). Before studying this, the possible chelation in phenylhydrazones of *o*-hydroxycarbonyl compounds was investigated.

The u.v. spectra of the phenylhydrazones of several *o*-hydroxy and *o*-methoxy carbonyl compounds have been studied and they are given in Table I. The u.v. spectrum of the phenyl

TABLE I

U.V. absorption data on phenyl hydrazones

Carbonyl compound	$\lambda_{\max,1}$ m μ (log ϵ)	$\lambda_{\max,2}$ m μ (log ϵ)
<i>o</i> -Methoxyacetophenone*	285 (3.90)	..
Salicylaldehyde (XVI)*	298 (4.28)	340 (3.98)
<i>o</i> -Hydroxyacetophenone (XVI a)*	296 (4.30)	335 (4.14)
Peonol (XVI b)†	.. 305 (4.19)	335 (4.42)

* Spectra taken in CHCl₃ solution;† Spectrum taken in CCl₄ solution.

hydrazone of *o*-methoxyacetophenone²² in which chelation is not possible shows only one band but those of *o*-hydroxy compounds, viz., *o*-hydroxy acetophenone,²³ salicylaldehyde²⁴ and peonol²⁵ show an additional band at higher wavelength. This suggests the possible chelation in the phenyl hydrazones of *o*-hydroxy carbonyl compounds (see formula XIX) and it is further supported by the greater stability of the hydroxy compounds in comparison with the methyl ethers. Thus the phenyl hydrazone of *o*-methoxy acetophenone decomposed completely in 2 days,²⁶ and that of 2,4-dimethoxyacetophenone is difficult to isolate.²⁵ A recent application of the presence of chelation in the phenyl hydrazone of *o*-hydroxy acetophenone is in the estimation of palladium.²⁷

Next the phenyl osazones of four *o*-hydroxyacetophenones, viz., simple one (XVII a), 4-methoxy- (XVII b), 2-hydroxy-4-methoxy- (XIX a), and 2-hydroxy-4,6-dimethoxy- (XIX b) have been studied. They are crystalline solids and are useful for characterisation of ketones. They are all stable; even osazones (XVIII a) and (XVIII b) which lack *o*-hydroxyl are stable as compared with the phenyl hydrazones because of the quasiaromatic osazone ring.

The u.v. spectra of the phenyl osazones in carbon tetrachloride solution are mentioned in Table II. Compounds (XVIII a and b) which

TABLE II

U.V. spectra of phenyl osazones of
o-hydroxyacetophenones in CCl₄ solution

Compound	$\lambda_{\max,1}$ m μ (log ϵ)	$\lambda_{\max,2}$ m μ (log ϵ)	$\lambda_{\max,3}$ m μ (log ϵ)
XVIII a ..	285-302 (4.41)	..	407-412 (4.38)
XVIII b ..	283 (1.16)	..	412-417 (4.03)
XX a ..	284 (4.04)	340 (3.95)	417-427 (3.90)
XX b ..	273 (4.34)	346 (4.25)	410-427 (4.40)

have no *ortho* hydroxy group show two bands of which the lower one could be attributed to the aromatic rings and the higher to the osazone chelate ring. Both these bands are retained in the other phenyl osazones (XX a and b) which possess the *ortho* hydroxyl group. But, in addition, there is a third band near 340 m μ which could be considered due to the additional chelate ring arising from *o*-hydroxyl of the benzene nucleus as shown in formula XX. That this additional chelation stabilises the osazone ring is supported by the bathochromic shift of the longest wavelength band in the spectra of (XX a and b) as compared to those of (XVIII a and b).

It may be emphasised here that osazones of *o*-hydroxy compounds have resemblance to sugar osazones which also exhibit three absorption bands though at comparatively lower wavelengths.⁸ This would support the presence of the extra chelation involving the hydroxyl in both cases.

PREPARATION OF PHENYL HYDRAZONES

Phenyl hydrazones were prepared by adding phenyl hydrazine hydrochloride (0.5 g.) and sodium acetate (0.8 g.) in water (5 ml.) to a solution of the carbonyl compound (0.4 g.) in a little alcohol and warming the resulting solution at 80–85° for 10 minutes. The solids were collected and crystallised from ethanol.

Phenyl hydrazones of *o*-methoxyacetophenone,²² *o*-hydroxyacetophenone,²³ salicylaldehyde²⁴ and peonol²⁵ agreed with the earlier recordings in literature.

PREPARATION OF PHENYL OSAZONES

(i) From *ω*-hydroxy-4-methoxyacetophenone (XVII b).—The ketone²⁸ (XXI, 500 mg.) was dissolved in warm 70% acetic acid (2.5 ml.) and added to a solution of freshly distilled phenyl hydrazine (1.30 g.) in 70% acetic acid (0.3 ml.). The mixture was heated at 80–85° for 30 minutes when a yellow crystalline mass separated. It was cooled, filtered and the solid washed first with a few drops of 70% acetic acid followed by a few drops of methanol. The osazone (450 mg.) crystallised from ethyl acetate as orange yellow needles, m.p. 196° d (Found: N, 16.3. $C_{21}H_{20}N_4O$ requires N, 16.4%).

(ii) From *ω*-hydroxyacetophenone (XVII a).—The osazone was obtained as yellow needles, m.p. 152° (lit.,²⁹ 152°).

(iii) From *ω*-2-dihydroxy-4-methoxy acetophenone (XIX a).—The ketone³⁰ (100 mg.) was reacted with phenyl hydrazine (0.260 g.) in the same way as above. The osazone crystallised from ethyl acetate as yellow needles, m.p. 220° (Found: C, 69.5; H, 5.6%; $C_{21}H_{20}N_4O_2$ requires C, 70.0; H, 5.6%).

(iv) From *ω*-2-dihydroxy-4, 6-dimethoxy acetophenone (XIX b).—The ketone³⁰ (300 mg.) was dissolved in acetic acid (3 ml.) and diluted

with water (0.5 ml.). This solution was mixed with phenyl hydrazine (0.9 g.) in 70% acetic acid solution (1.5 ml.) and the mixture heated for 1 hour at 90–95°. After cooling, the product was filtered, dried and crystallised from ethyl acetate when the osazone separated as yellow needles, m.p., 222–23° (Found: C, 67.2, H, 5.5; $C_{22}H_{22}N_4O_3$ requires C, 67.7; H, 5.6%).

1. Fischer, E., *Ber. Dtsch. Chem. Ges.*, 1884, 17, 579.
2. —, *Ibid.*, 1887, 20, 821.
3. Fieser, L. F. and Fieser, M., *Organic Chemistry*, Heath & Co., Boston, Mass., 1944, p. 351.
4. Mester, L., Moczar, E. and Parello, J., *J. Amer. Chem. Soc.*, 1965, 87, 596.
5. —, *Angew. Chem. Internat., Ed.*, 1965, 4, 574.
6. Bjamer, K., Dahn, S., Furberg, S. and Petersen, C. S., *Acta Chem. Scand.*, 1963, 17, 559.
7. Chapman, O. L., Welstead, W. J., Murphy, T. J. and King, R. V., *J. Amer. Chem. Soc.*, 1964, 86, 732.
8. Henseke, G. and Binte, H. J., *Chimia*, 1958, 12, 103.
9. Fischer, E., *Ber. Dtsch. Chem. Ges.*, 1890, 23, 2114.
10. Wolf, U., *Chem. Ber.*, 1953, 86, 840.
11. Weygand, F., *Ber. Dtsch. Chem. Ges.*, 1940, 73, 1240.
12. —, Simon, H. and Klebe, J. F., *Chem. Ber.*, 1968, 91, 1507.
13. —, — and Ardenne, U. R., *Ibid.*, 1959, 92, 3117.
14. Simon, H., Keil, K. D. and Weygand, F., *Ibid.*, 1962, 95, 17.
15. —, Dorrer, H. D. and Trebst, A., *Ibid.*, 1963, 96, 1285.
16. Shemyakin, M. M., Maimind, V. I., Ermolaev, K. M. and Bamdas, E. M., *Tetrahedron*, 1965, 21, 2771.
17. Micheel, F. and Dijong, V. I., *Liebigs Ann. Chem.*, 1963, 669, 136.
18. Dijong, V. I. and Micheel, F., *Ibid.*, 1965, 684, 217.
19. Leon, A., Robertson, A., Robinson, R. and Seshadri, T. R., *J. Chem. Soc.*, 1931, p. 2672.
20. Charlesworth, S. H., Chavan, J. J. and Robinson, R., *Ibid.*, 1933, p. 372.
21. Jain, A. C. and Seshadri, T. R., *Phytochem.*, 1964, 3, 381.
22. Klages, A. and Eppelsheim, A., *Ber. Dtsch. Chem. Ges.*, 1903, 36, 3589.
23. Torrey, H. A. and Brewster, C. M., *J. Amer. Chem. Soc.*, 1913, 35, 441.
24. Fischer, E., *Ber. Dtsch. Chem. Ges.*, 1897, 30, 1243.
25. Adams, R., *J. Amer. Chem. Soc.*, 1919, 41, 260.
26. Wahl, A. and Silberzweig, C., *Bull. soc. chim. Fr.*, 1912, 11 (4), 68.
27. Umapathy, P., Venkatarreddy, D. and Appala Raju, N., *Ind. J. Chem.*, 1965, 3, 471.
28. Boeseken, J., Hansen, L. W. and Bertram, S. H., *Rec. trav. chim.*, 1916, 35, 312.
29. I aumann, A., *Liebigs Ann. Chem.*, 1888, 243, 247.
30. Grover, S. K., Gupta, V. N., Jain, A. C. and Seshadri, T. R., *J. Sci. and Industr. Res.*, 1960, 19 B, 258.

UPTAKE AND TRANSLOCATION OF SULPHANILAMIDE AND GRISEOFULVIN BY THE RICE PLANT *

S. N. S. SRIVASTAVA

Central Potato Research Institute, Simla-1

BOTH sulphanilamide and griseofulvin are known to be absorbed by the roots of several plants and translocated to the shoots.^{2,3,5,8} No reports, however, exist on the uptake of sulphanilamide by the rice plant; that of griseofulvin has been observed,⁹ but no quantitative assay was made. During the course of a study of their role in the systemic control of brown spot (*Cochliobolus miyabeanus* Ito et Kuribayashi, Drechsler) of rice, the amount of the two compounds taken up by the rice plants was investigated. The results are reported in the present paper.

Rice seed was supplied by the Paddy Specialist,** Agricultural College and Research Institute, Coimbatore, and griseofulvin and *Botrytis allii* culture by Prof. P. W. Brian** of the University of Glasgow. A May and Baker's preparation of sulphanilamide was procured locally. The two chemicals were recrystallised from solutions in acetone and ethanol, respectively, before use.

Plants were grown in liquid culture.⁷ At 10 days' age, sulphanilamide at 100 µg./ml. and griseofulvin at 25 µg./ml. were added to the nutrient solution. The free sulphanilamide content of the plants was estimated 3 days after treatment by the methods of Crowdy and Pramer⁴ and Crowdy and Rudd Jones,⁵ partly modified after Snell and Snell.⁶ Free griseofulvin was estimated 4 days after treatment by the bioassay method using *B. allii*.¹

Fresh plant tissue was used in the studies. Samples consisted of a minimum of 0.5 g. roots and 1 g. shoots. Extracts were made using a hand pestle and mortar. Standards were prepared in untreated plant extracts. Duplicates were run in each case.

Uptake of Sulphanilamide.—The free sulphanilamide content was estimated in the roots and shoots of rice varieties Co₁₃ and Adt₁₀ separately. The residual sulphanilamide in the nutrient solution was also estimated. The plant tissue was quickly washed, wiped between folds of filter-paper, and killed by dipping in ether for 30 sec. Extracts were filtered and dried over sulphuric acid *in vacuo*. The residue was taken up in 6 ml. water and pH adjusted to 7. To 3 ml.

aliquots were added 2 ml. of 15% trichloroacetic acid and the mixture centrifuged for 20 min. at 3000 r.p.m. To 2 ml. of the supernatant was added 0.5 ml. of 0.1% sodium nitrite solution and the tube shaken. This was followed by the addition of 2 ml. of 4% ammonium sulphamate and 1 ml. of 0.1% N-(1-naphthyl) ethylenediaminedihydrochloride. The resulting pink colour was read in a Hilger's Uvispek spectrophotometer at 545 mµ and the quantity of sulphanilamide computed from a standard graph. The amount of sulphanilamide remaining in the nutrient solution was likewise estimated by taking 0.5 ml. aliquots directly. The results are given in Table I.

TABLE I
Free sulphanilamide content of rice plants treated through roots and the balance in the nutrient solution

Variety	Sulphanilamide content (µg./plant)		Residual sulphanilamide in nutrient solution (µg./ml.)
	Shoot	Root	
1. Co ₁₃	3.2	1.1	50.25
2. Adt ₁₀	2.0	0.8	51.25

It will be seen that 3–4 µg. of free sulphanilamide was detected per plant, while almost half of the quantity supplied was left over in the nutrient solution. The quantity present in the shoots was about 3 times that in the roots.

Uptake of Griseofulvin.—Preliminary experiments showed little difference in the uptake of griseofulvin by the rice varieties Co₁₃ and Adt₁₀. Detailed studies were, therefore, undertaken with the variety Adt₁₀ alone. Only shoots were analysed. The tissue was killed and extracted as mentioned earlier. The extract was made up to 5 ml. and aliquots used for bioassay. The results are presented in Figs. 1–7.

It will be seen from Figs. 2 and 3 that the abnormalities produced in the germination of the conidia of *B. allii* in the treated plant extract was identical with their germination in the untreated plant extract to which 25 µg./ml. griseofulvin had been added. But a comparison of the dilution end point, 1/16 or 1/32, with the standards (Figs. 4–7) suggested a probable concentration of 6.4 µg./ml. in the extract, thus working to about 2 µg. free griseofulvin per plant.

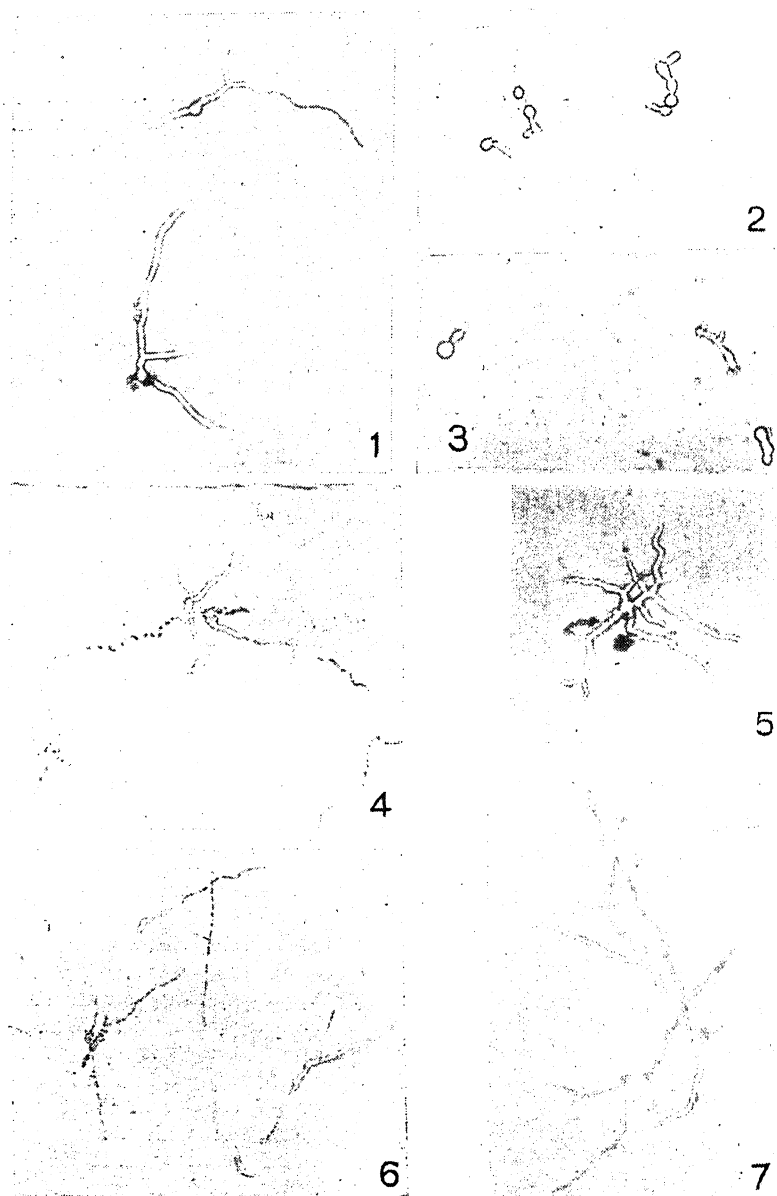
It is, therefore, concluded that both sulphanilamide and griseofulvin are absorbed by the roots

* Adopted from Ph.D. thesis approved by the University of Madras.

** Grateful thanks are due to them.

or rice plants and translocated to the shoots within 3-4 days. In treatments with 100 $\mu\text{g./ml.}$ sulphanilamide and 25 $\mu\text{g./ml.}$ griseofulvin, 3-4 $\mu\text{g.}$ of free sulphanilamide and 2 $\mu\text{g.}$ of free griseofulvin could be detected per plant at the end of that period.

Thanks are due to the University of Madras for permission to work in the University Botany Laboratory, and to Prof. T. S. Sadasivan, Director of the Laboratory, for guidance. I am also indebted to Prof. E. R. B. Shanmugasundaram of the Biochemistry Department, University of



FIGS. 1-7. The germination of conidia of *Botrytis allii* in aqueous extracts of shoots of rice plants ($\times 130$). Fig. 1. Untreated plant extract, undiluted. Fig. 2. Treated* plant extract, undiluted. Fig. 3. Untreated plant extract + 25 $\mu\text{g./ml.}$ griseofulvin. Fig. 4. Treated* plant extract, diluted 16 times. Fig. 5. Untreated plant extract + 0.4 $\mu\text{g./ml.}$ griseofulvin. Fig. 6. Treated* plant extract, diluted 32 times. Fig. 7. Untreated plant extract + 0.2 $\mu\text{g./ml.}$ griseofulvin.

*Treated with 25 $\mu\text{g./ml.}$ griseofulvin.

Madras, for advice, and the Plant Protection Adviser to the Government of India for permission to undertake the work.

1. Brian, P. W., Curtis, P. J. and Hemming, H. G., *Trans. Brit. mycol. Soc.*, 1946, **29**, 173.
2. Crowdy, S. H., *Ann. appl. Biol.*, 1957, **45**, 208.
3. —, Grove, J. F., Hemming, H. G. and Robinson, K. C., *Jour. exp. Bot.*, 1956, **7**, 42.
4. —, and Pramer, D., *Ann. Bot. Lond., N.S.*, 1955, **19**, 79.

5. Crowdy, S. H., and Rudd Jones, D., *Jour. exp. Bot.*, 1956, **7**, 335.
6. Snell, Foster Dee and Snell, Cornelia, T., *Colorimetric Methods of Analysis*, D. van Nostrand Co. Inc., New York, 1954, **4**.
7. Srivastava, S. N. S., "Systemic Fungicides and Host Parasite Response," *Ph.D. Thesis*, Univ. Madras, 1964.
8. Stokes, Anne, *Plant and Soil*, 1954, **5**, 132.
9. Subba Rao, N. S., *Proc. Ind. Acad. Sci.*, 1957, **46 B**, 65.

THE INDIAN SHAD, *HILSA ILISHA* (HAMILTON) IN THE SEA

S. DUTT

Department of Zoology, Andhra University, Waltair

THE Indian shad, *Hilsa ilisha* (Ham.), has long been considered as a fluvial anadromous fish with feeding grounds in the sea and spawning grounds along considerable stretches of the lower and middle reaches of big as well as small rivers of India. However, Prashad¹ and Hora² cast doubt on the true anadromous habit of this valuable clupeid and considered it as a fluvial fish that does not go down beyond the estuary; since then, although various workers have observed either juveniles or adults in inshore waters,³⁻⁹ there has been some reluctance to consider the anadromous habit of hilsa. It is stated that even if hilsa does enter the sea, it is confined to inshore waters or to the "foreshore";^{4-8,9} it is however most unlikely that this medium-sized active fish resorts to an intertidal habitat during its extra-fluvial phase. A review of the literature shows that the fluvial anadromous stocks of hilsa do enter the sea, but that the available data on the movements in the sea are inadequate to determine the extent of their seaward migration because there are just no observations, negative or positive, beyond the continental shelf.

The recent record by Pillay¹⁰ of maturing, mature and spent hilsa in the sea, 9 to 12 miles off Veraval (in Saurashtra, Gujarat State) on the north-west coast of India adds a new dimension to the known behaviour of this fish; Pillay offers evidence that this particular stock of hilsa probably spawns in the sea. All previous records of mature and spent hilsa are from rivers.

Nikolsky¹¹ has observed that the reasons why anadromous fishes have not migrated completely to the sea where there are more favourable feeding conditions, but have retained their spawning grounds in freshwater, are

1. if they transferred their spawning grounds also to the sea, they would have to protect their spawn, as otherwise the latter would all be eaten, and

2. since migratory fishes mostly have a considerable hunting area and perform considerable feeding migrations, the adults would starve and die if they were to remain on the spawning ground to protect their spawn through a protracted incubation period. By retaining spawning grounds in the river, the eggs can develop through at least part of the juvenile stage in the river, where they are subject to far less danger than in the sea.

If the Saurashtra stock of hilsa does breed in the sea, how has it solved the problem of spawning in a *milieu* new to the species? Specifically, what is the type of eggs (demersal, semibuoyant or pelagic) and how have the problems of protection of eggs and larvæ and of osmoregulation been solved? The eggs of hilsa spawning in rivers are demersal;⁶⁻¹² they rest lightly on the bottom in still water and drift when there is a current;¹²⁻¹³ the eggs and larvæ are not guarded or protected by the parents. Further, how does the fecundity of the Saurashtra hilsa compare with that of the stocks spawning in rivers? In this connection, it should be noted that in the same region, there is a fluvial anadromous stock spawning in the Narbada River.¹²⁻¹⁵ One may expect that if the Saurashtra stock of hilsa does breed in the sea, the fecundity should be at a higher level than that of normal stocks spawning in rivers (where mortality of eggs and larvæ would be much less) if the former stock in its new *milieu* is not to decline. A comparison of the fecundity of mature hilsa from Saurashtra coast and from Narbada River should prove valuable.

The investigations to date on *Hilsa ilisha* thus indicate the possible existence of three ecotypes of this species:

1. Fluvial anadromous stocks that feed and grow in coastal waters and spawn in middle or lower reaches of rivers above

the level of tidal influence. Such would be the hilsa of the Hooghly, Godavari and Narbada.

2. Fluvial hilsa (physiologically but not geographically land-locked stocks) that inhabit the middle reaches of rivers and are potamodromous. Such are probably the hilsa as occur at Delhi, Agra, Allahabad and Buxar in the rivers Jamuna and Ganga.¹⁶⁻¹⁹ According to Jhingran,¹⁸ adult hilsa occur at Buxar throughout the year and Pillay, Rao and Mathur¹⁹ suggest that hilsa of the upper Ganga do not go even to the lower reaches of the Ganga-Brahmaputra system.
3. Marine hilsa as have been observed by Pillay¹⁰ off Veraval on the Saurashtra coast. It is not yet established whether these are 'purely' marine or whether the juveniles observed in the nearby Kodinar area²⁰ are the progeny of the adult mature hilsa that apparently spawn at sea. Pillay¹⁰ states that adult hilsa do not occur in the small rivers in the neighbourhood.

The first of the above three types is the normal condition in this species, and there is extensive literature pertaining to this type.²¹ Relevant references since 1952 are given at the end of this paper. However, there are still lacunæ in our knowledge of the movements of the anadromous stocks. At what stage in their life do fluvial anadromous hilsa descend to the sea? There are two views with regard to the period of life when they undertake the downward migration for the first time. According to Raj,²² based on observations in South Indian rivers, they spend the first two years in estuaries and the third year at sea before returning to the river for spawning, while Prashad, Hora and Nair²³ and Jones and Menon⁶ believe that in the Hooghly, they descend into the sea during the first year of their life. There is no doubt that juveniles occur in the rivers^{2,6,20,24,25} and can grow in confined water.^{2,26} Juveniles are also reported as having been observed in the sea.^{6,7,9} A biometric analysis of these juvenile fish caught in the sea should prove rewarding. Most of the work on adult hilsa is on specimens collected in rivers and estuaries. Practically no investigations have been carried out on adult hilsa caught in the sea. The records of hilsa in the sea^{4,5,7,8} presumably refer to adult hilsa. Pillay⁹ specifically refers to catches of large hilsa in winter at Junput on Contai coast in West Bengal.

One major reason for our limited knowledge of the behaviour of hilsa is that studies to date

have been based on commercial catches, which are neither satisfactory nor adequate, because commercial gear is selective by its very nature and/or seasonal in its application. The problem of the extent of migration of the hilsa can be solved by employing, at frequent and regular intervals throughout the year, suitable least-selective types of gear at various points in the rivers, in the estuaries and in the sea, and by large-scale tagging. It is recognised that these are expensive studies, but probably not much more expensive than a number of discrete observations, restricted in scope or in area of investigation. Such studies are moreover justified by the fact that they would help to determine any regulation of fishing seasons, size groups and quantities that may have to be introduced.

The author is grateful to Dr. P. N. Ganapati for going through the manuscript.

1. Prashad, B., *Ann. Rept. Dept. Fish. Bengal, Bihar and Orissa, Calcutta*, 1919.
2. Hora, S. L., *Rec. Indian Mus.*, 1938, 40 (2), 147.
3. Mojumdar, C. H., *Sci. and Cult., Calcutta*, 1939, 5 (4), 219.
4. Chacko, P. I. and Ganapati, S. V., *J. Madras Univ.*, 1949, 18, 16.
5. — and Dixithulu, D. V. H., *Proc. 38th Indian Sci. Congr.*, 1951, Pt. III (Abst.), p. 227.
6. Jones, S. and Menon, P. M. G., *Proc. Ind. Acad. Sci.*, 1951, 31 (3), 101.
7. — and Sujansingani, K. H., *J. Bombay nat. Hist. Soc.*, 1951, 50, 261.
8. —, *Indian J. Fish.*, 1957, 4 (2), 304.
9. Pillay, T. V. R., *Proc. Ind. Acad. Sci.*, 1958, 47 (3), 155.
10. Pillay, S. R., *Proc. nat. Inst. Sci. India*, 1961, 30B (1), 8.
11. Nikolsky, G. V., *The Ecology of Fishes*, Academic Press, London, 1963.
12. Kulkarni, C. V., *Proc. nat. Inst. Sci. India*, 1950, 16 (3), 169.
13. Karamchandani, S. J., *Curr. Sci.*, 1961, 30 (10), 373.
14. Kulkarni, C. V., *J. Bombay nat. Hist. Soc.*, 1951, 49 (4), 615.
15. —, *J. Asiatic Soc. Sci.*, 1954, 20 (1), 47.
16. Hora, S. L., *Curr. Sci.*, 1942, 11 (12), 470.
17. Varma, C. P., *J. Asiatic Soc. Sci.*, 1954, 20 (1), 41.
18. Jhingran, V. G., *Indian J. Fish.*, 1957, 4 (2), 336.
19. Pillay, S. R., Rao, K. V. and Mathur, P. K., *I.P.F.C., Proc. 10th Session, 1963, Sec. II*, p. 28.
20. Pillay, T. V. R. and Shaw, J. S., *J. Bombay nat. Hist. Soc.*, 1949, 48, 775.
21. Jones, S., *J. zool. Soc. India*, 1952, 4 (1), 89.
22. Raj, B. S., *Proc. nat. Inst. Sci. India*, 1951, 17 (1), 1.
23. Prashad, B., Hora, S. L. and Nair, K. K., *Rec. Indian Mus.*, 1940, 42 (4), 529.
24. Sujansingani, K. H., *Indian J. Fish.*, 1957, 4 (2), 315.
25. Bhimachar, B. S., *Ann. Rep. C.I.F.R.S., Barrackpore*, 1958.
26. Raj, B. S., *J. and Proc. Asiatic Soc. Bengal (N.S.)*, 1917, 13, 184.

LETTERS TO THE EDITOR

NORMAL CO-ORDINATE ANALYSIS OF THE IN-PLANE VIBRATIONS OF o-, m-, p- FLUOROCHLORO AND FLUOROBROMO BENZENES

THE infra-red and Raman spectra of halogenated benzenes have been studied and their vibrational frequencies assigned by several workers. Narasimham *et al.*¹ studied the vibrational spectra of o-, m-, p-fluorochloro benzenes (o-FCB, m-FCB, p-FCB) and p-fluorobromo benzene (p-FBB) and proposed vibrational assignments, some of which are not in agreement with the studies of Varsanyi *et al.*² A normal co-ordinate analysis of the vibrations of o-, m-, p-, FCB and FBB is therefore undertaken with a view to ascertain the correctness of the proposed assignments. As a part of this programme, the in-plane vibrations of the benzenes are calculated using Wilson's F-G matrix method.³ The form of the potential function is of the modified Urey-Bradley type and is given by

$$2V = \Sigma [K_{ij} (\Delta r_{ij})^2 + 2K_{ij}' r_{ij} \Delta r_{ij}] \\ + \Sigma [H_{ij} (r_{ij} \Delta a_{ij})^2 + 2H_{ij}' (r_{ij} \Delta a_{ij})] \\ + \Sigma [F_{ij} (\Delta q_{ij})^2 + 2F_{ij}' q_{ij} \Delta q_{ij}] \\ + \Sigma [C_{ij} (\Delta q_{ij})^2 + 2C_{ij}' q_{ij} \Delta q_{ij}] \\ + 2\rho [\Sigma \Delta r_{c_i c_{i+1}} \Delta r_{c_{i+1} c_{i+2}} \\ + \Sigma \Delta r_{c_i c_{i+1}} \Delta r_{c_{i+3} c_{i+4}} \\ - \Sigma \Delta r_{c_i c_{i+1}} \Delta r_{c_{i+2} c_{i+3}}]$$

where ρ is the Kekule's constant; Δr_{ij} and Δq_{ij} refer to the bonded and non-bonded co-ordinates respectively; K_{ij} , H_{ij} , F_{ij} and C_{ij} refer to the force constants for bond stretching, angle bending, gem and cis non-bonded co-ordinates respectively. It is assumed that $F' = -0.1 F$ and $C' = -0.1 C$.

The initial set of force constants used in the present calculations has been borrowed mostly from the work on symmetric tri-halogenated benzenes by Scherer *et al.*⁴ The force constants have been refined by the method suggested recently by Shimanouchi⁵ so as to get a least square fit between the observed and calculated vibrational frequencies in each of the two sets of the above dihalogenated benzenes. The correctness or otherwise of the assignments in these molecules has been determined by the zero-order and partially refined calculations.

The present calculations of the in-plane vibrational frequencies show a large measure of agreement with the vibrational assignments

proposed by Narasimham *et al.* and Varsanyi *et al.* However, there are a few significant differences, which suggest the following revision of some of the earlier assignments.

In p-FCB, the band at 337 cm.⁻¹ is suggested by the above authors as the lowest in-plane b_1 fundamental. But the present calculations predict this mode at 272 cm.⁻¹ There is however a fundamental at 267 cm.⁻¹ assigned by both as the lowest out-of-plane b_2 fundamental. This should indeed be taken as the lowest in-plane b_1 fundamental. A similar situation obtains in p-FBB for the band at 224 cm.⁻¹ which ought to have been the lowest b_1 fundamental. The same is true of the bands of o-FCB and m-FCB at 269 cm.⁻¹ and 262 cm.⁻¹ respectively which should be assigned as the lowest a' fundamentals.

In p-FCB Varsanyi *et al.* assign 1430 cm.⁻¹ band as one of the b_1 fundamentals but no fundamental at this frequency is given in the assignments of Narasimham *et al.* The band at 1266 cm.⁻¹ is assigned as a fundamental by Narasimham *et al.* whereas it is not considered as a fundamental by Varsanyi *et al.* The present calculations give a value at 1264 cm.⁻¹ which supports the assignment of Narasimham *et al.* There is however a calculated frequency at 1407 cm.⁻¹ which is in agreement with the b_1 fundamentals 1403 and 1402 assigned by both. This therefore eliminates the 1430 cm.⁻¹ frequency as a fundamental.

Similar situation obtains in m-FCB where the band at 476 cm.⁻¹ is to be taken as an a' fundamental mode as assigned by Varsanyi *et al.* and not the band at 1132 cm.⁻¹, as assigned by Narasimham *et al.* Likewise, the band at 1274 cm.⁻¹ in p-FBB is to be taken as the b_1 fundamental as assigned by Narasimham *et al.* and not the one at 1429 cm.⁻¹ assigned by Varsanyi *et al.*

It is however gratifying to note that the above-mentioned assignments for the lowest in-plane b_1 fundamentals in p-FCB and p-FBB are in agreement with the recent observations of Thompson⁶ from high resolution infra-red data.

All the computations have been performed on the CDC 3600 computer using FORTRAN programmes. Details of the results of the calculations will be published elsewhere.

Our thanks are due to Professor J. Rud Nielsen for helpful discussions and Professor

H. W. Thompson for intimating us, in advance of publication, the infra-red data in the low wave-number region for *p*-FCB and *p*-FBB.

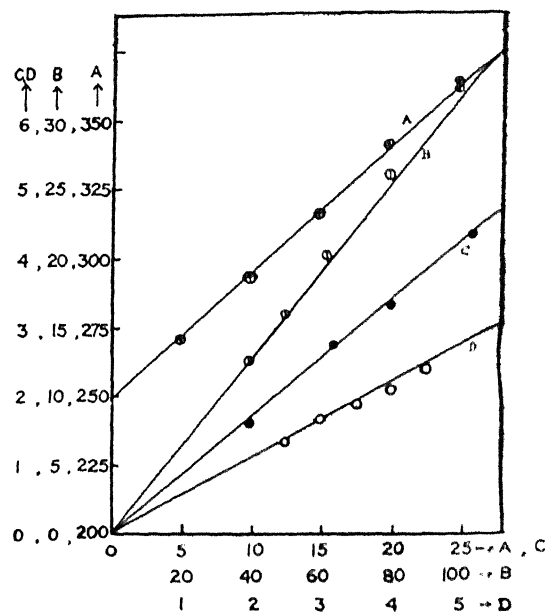
Spectroscopy N. A. NARASIMHAM.
Division, CH. V. S. RAMACHANDRA RAO.
Atomic Energy Establishment,
Trombay 414 A, Cadell Road,
Bombay-28, May 12, 1966.

1. Narasimham, N. A., El-Sabbhan, M. Z. and Rud Nielsen, J., *J. Chem. Phys.*, 1956, **24**, 420; Narasimham, N. A. and Rud Nielsen, J., *Ibid.*, 1956, **24**, 433; Harris, F. W., Narasimham, N. A. and Rud Nielsen, J., *Ibid.*, 1956, **24**, 1232.
2. Varsanyi, G., Holly, S. and Farago, T., *Spectro. Chem. Acta*, 1963, **19**, 669, 675, 683 and the references given therein.
3. Wilson, E. B., Decius, J. C. and Cross, P., *Molecular Vibrations*, McGraw-Hill, New York, 1955.
4. Scherer, J. R., Evans, J. C. and Muelder, W. W., *Spectro. Chem. Acta*, 1962, **18**, 1579.
5. Takehiko Shimanouchi and Isao Suzuki, *J. Chem. Phys.*, 1965, **42**, 296.
6. Thompson, H. W., Private Communication.

KINETICS OF OXIDATION OF BENZYL ALCOHOL BY AQUEOUS CERIC IONS

OXIDATION of various alcohols—*n*-, iso-Propanols; *n*-, iso-, Sec-, ter-Butanols; *n*-, iso-, Sec-, ter-Amyl alcohols; Cyclohexanol, etc.—by ceric perchlorate in perchloric acid medium proceeds through the formation of an intermediate complex (between Ce^{4+} and alcohol) which disproportionates unimolecularly. The reaction between Ce^{4+} and benzyl alcohol in perchloric acid has now been studied with a view to compare oxidation of the latter with that of methanol and to see the effect of the substituent phenyl group in the latter on the course of oxidation. Normally the reaction was fast but under conditions [Benzyl Alcohol]/[Ce^{4+}] = 3–8 in 1M $HClO_4$ at 15°C. measurable rate was obtained. The reaction was followed by determining the rate of ceric disappearance in the temperature range 10–20°C, with [$HClO_4$] = 1 to 1.5M, the ionic strength being maintained at 2.1. We present our results as follows: The reaction was found to be second order being first order each with respect to [Ce^{4+}] and [Benzyl Alcohol] as shown in Fig. 1. At constant ionic strength the rate increased with increase in [H^+] (0.5 to 2M). Plot of 1/rate vs. 1/[H^+] was linear with an intercept suggesting Ce^{4+} (aq) [and not $Ce^{4+} OH^-$ (aq)] or a complex of Ce^{4+} + alcohol (cf. Ref. 1)] was kinetically the active species. It can be seen from Fig. 1 that plot of $1/k_{obs}$ vs. 1/[Benzyl Alcohol] is linear leaving no intercept which indicates also that there is no complexing

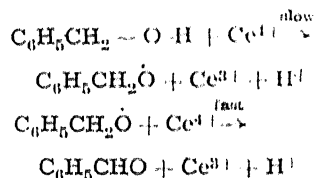
between benzyl alcohol and Ce^{4+} . Increase in ionic strength increased the rate indicating normal salt effect. Effect of initially added



A : Second order plot of $1/a-x$ Vs Time (mts)
B : Plot of $1/k_{obs}$ Vs [Benzyl Alcohol] at 15°C
C : Plot of k_{obs} Vs [Benzyl Alcohol] $\times 10^3$ at 10°C
D : Plot of $-R_{Ce^{4+}}$ Vs [Ce^{4+}] at 15°C

FIG. 1

cerous perchlorate decreased the rate. A mechanism based on fission of O-H bond in the alcohol followed by electron transfer to Ce^{4+} producing benzaldehyde which is also further rapidly oxidised explains all the observed features:



$$K = 1.164 \times 10^{13} \exp. (-18920/RT)$$

l moles⁻¹ sec.⁻¹ at 15°C. and

$$A = e (KT/h) \exp. (-0.7044/RT)$$

l moles⁻¹ sec.⁻¹ have been observed.

The absence of complexing between Ce^{4+} and benzyl alcohol may be explained on the basis of the phenyl group being electron withdrawing (cf. CH_3 in CH_3OH is electron releasing²) thus preventing co-ordination, at the same time

weakening the O-H bond of the alcohol making it susceptible to direct attack by Ce^{4+} .

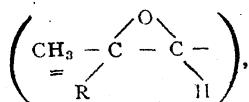
Dept. of Physical Chemistry, M. RANGASWAMY.
University of Madras, M. SANTAPPA.
Madras-25, January 10, 1966.

1. Rangaswamy, M. and Santappa, M., *Curr. Sci.*, 1965, **34**, 282.
2. Vijayachandar Rao, K. and Muhammad, S. S., *Bull. Chem. Soc., Japan*, 1963, **36** (8), 943.

CITRAL EPOXIDE*

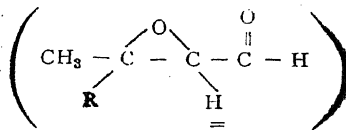
LINALOOL the unsaturated tertiary mono terpene alcohol is one of the most important aromatic isolates, used widely in the perfume, cosmetics, soap and flavour industries. Linalool and its esters especially the acetate are widely distributed in nature, both dextro and laevo rotatory forms are known.¹ Structure of linalool has been proved rigorously both synthetically and by degradation experiments.² In India Mysore is the only State where the production of linaloe oil, which contains a high percentage of linalyl acetate and linalool, is carried out from the natural source.³ On the other hand India is still the principal producer of lemongrass oil of which citral is a major constituent. Recently hydrazine reductions of α , β -epoxy ketones and aldehydes to allylic alcohols have proved useful in synthetic organic chemistry,⁴ and hence it was considered of interest to explore the possibility of conversion of citral epoxide to linalool from the preparative point of view.

Citral used for the present investigation was isolated from lemongrass oil.⁵ Its NMR spectrum⁶ indicates that it is an approximately 50:50 mixture of geometrical isomers citral a and citral b. This was converted to known (\pm) citral epoxide⁷ using hydrogen peroxide in acetone and 5% sodium carbonate solution.⁸ (\pm) Citral epoxide thus obtained had b.p. 140° (bath)/20 mm., n_{20}^D 1.4695, no strong ultra-violet absorption around 235 m μ , strong IR band at 1720 cm.⁻¹ due to $>C=O$. Found: C, 71.37; H, 9.75. $C_{10}H_{16}O_2$ requires: C, 71.39; H, 9.59%. The NMR spectrum⁹ of the (\pm) epoxide shows that it is an approximately 50:50 mixture of (\pm) citral epoxide (I) and citral epoxide (II). It gave two singlets at 8.56 and 8.62 τ

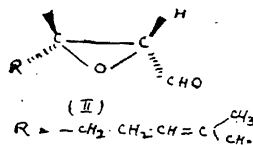
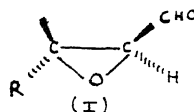
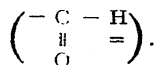


signals at 8.32 and 8.38 τ (two methyls of

isopropylidene group), two doublets at 6.9 and 7.05 τ



multiplet at 5.0 τ (olefinic proton in the isopropylidene group) and two doublets centered at 0.66 and 0.55 τ



Reduction of the above citral epoxide with hydrazine is being studied under different conditions, to explore the possibility of getting linalool on preparative scale.

We thank Dr. S. C. Bhattacharyya for his interest in this investigation.

National Chemical Laboratory, V. K. HONWAD
Poona, April 18, 1966. A. S. RAO.

*Communication No.928 from the National Chemical Laboratory, Poona 8.

1. Ernest Guenther, *The Essential Oils*, D. Van Nostrand Co., Inc., 1949, **2**, 167.
2. Sir John Simonsen, *The Terpenes*, Cambridge University Press, 1931; **1**, 46.
3. *The Wealth of India (Raw Materials)*, Council of Scientific and Industrial Research, New Delhi, 1948, **1**, 250.
4. (a) Wharton, P. S. and Bohlen, D. H., *J. Org. Chem.*, 1961, **26**, 3615.
(b) Klein, E. and Ohloff, G., *Tetrahedron*, 1963, **19**, 1091.
5. Supplied by S. H. Kelkar and Co. (P) Ltd., Bombay.
6. Venuto, P. B. and Day, A. R., *J. Org. Chem.*, 1964, **29**, 2735.
7. Payne G. B., *Ibid.*, 1961, **26**, 250.
8. Kornfeld, E. C. Kline, G. B., Mann, M. J., Morrison, D. E., Jones, R. E. and Woodward, R. B., *J. Amer. Chem. Soc.*, 1956, **78**, 3108.
9. NMR spectrum is taken at 60 megacycles using tetramethylsilane as internal standard in CCl_4 .

OXIDATION OF RUBEANIC ACID BY CHLORAMINE-T

RUBEANIC ACID (Dithiooxamide) is widely used as a reagent for the identification of cations, e.g., in spot-tests and in paper chromatography. In view of the ability of chloramine-T to oxidize a variety of sulphur compounds,¹⁻⁸ converting the entire sulphur in them to sulphuric acid, it was considered worthwhile to study the behaviour of this oxidant towards rubeanic acid. The results of such a study are presented in this communication.

Reagents.—Merck "Guaranteed Reagent Analysis" Rubeanic Acid was employed for the present work. The purity of the sample was checked by total sulphur determination⁹ and was established to be 99.63%. Standard solutions of rubeanic acid were prepared by dissolving known weights of the sample in normal sodium hydroxide solution. Stock decinormal solutions of chloramine-T were prepared, standardized and preserved, in conformity with the recommendations of Bishop and Jennings.¹⁰

Procedure.—Measured aliquots (25 ml) of the chloramine-T solution were taken in 500 ml glass-stoppered conical flasks and 15 ml of 1N sodium hydroxide were added to each. Known volumes of the standard rubeanic acid solutions were now introduced with shaking. The mixtures were heated to 60° and kept at that temperature for about half an hour, when the solutions became clear. The solutions were cooled to room temperature and 30 ml 2N sulphuric acid and 15 ml 10% potassium iodide were added. The liberated iodine was estimated by titrating it with standard thiosulphate. Blanks were run concurrently; no blank corrections were necessary. From the amount of chloramine-T consumed, the ratio of equivalents of oxidant consumed per mole of rubeanic acid was calculated. Typical results are given in Table I.

In a separate series of experiments, the excess of chloramine-T remaining unused in the alkaline medium was determined by adding a known volume (excess) of standard 0.2N sodium arsenite solution and determining the unreacted arsenite by titrating, in a bicarbonate buffer, in presence of potassium iodide and starch, with standard decinormal chloramine-T solution to a permanent pale blue end point as suggested by Bishop and Jennings.¹⁰ Typical results of such experiments are also included in Table I (Expts. 7 and 8).

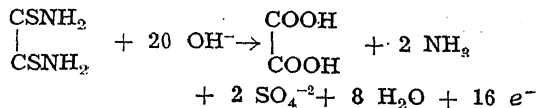
Results and Remarks.—It may be seen from Table I that sixteen equivalents of oxidant are consumed per mole of rubeanic acid. This is

TABLE I

Oxidation of rubeanic acid by chloramine-T

Expt. No.	Millimoles of rubeanic acid taken	Milliequivalents of chloramine-T consumed	No. of equivalents of oxidant consumed per mole of rubeanic acid
1	0.1607	2.549	15.86
2	0.2678	4.246	15.86
3	0.3306	5.318	16.08
4	0.3403	5.444	16.00
5	0.3857	6.194	16.06
6	0.5104	8.104	16.00
7	0.2784	4.418	15.87
8	0.3394	5.458	16.08

in agreement with the following oxidation scheme :



The large number of equivalents of oxidant consumed per mole of the substance indicates that the chloramine-T oxidation method should be a very accurate analytical procedure for the estimation of rubeanic acid.

The results of expts. 7 and 8 (in which the excess oxidant was removed while the medium remained alkaline) are found to be in no way different from those of expts. 1 to 6 (in which the excess oxidant was determined after acidification). This shows conclusively that the oxidation of rubeanic acid is completed in the alkaline medium itself.

Among the products of oxidation, ammonia is not further oxidized by chloramine-T under these conditions.^{1,11} Independent experiments carried out by the present authors have shown that oxalic acid is not further oxidized by chloramine-T under the present experimental conditions.

In the present investigation, the oxidation of rubeanic acid by chloramine-T was studied under various conditions. The oxidation was found to be incomplete in an acidic medium at room temperature (28°) or even at 60°. Oxidation in alkaline medium was also found to be incomplete at room temperature; a turbidity due to partial separation of elemental sulphur was visible in this case. The turbidity disappeared on warming to 60°. Finely divided sulphur is known to react quantitatively with alkali forming a mixture of sulphide, sulphite and thiosulphate;¹² all of these sulphur oxy-anions are further oxidized by chloramine-T to the sulphate ion.⁶

Financial assistance from the University Grants Commission is gratefully acknowledged. We also thank the Government of India for the award of a Junior Research Fellowship to one of us (T. J. J.).

Dept. of Chemistry, T. JOSE JACOB.
Univ. of Kerala, C. G. RAMACHANDRAN NAIR.
Trivandrum-1 (India),
February 23, 1966.

1. Jose Jacob, T. and Nair, C. G. R., *Talanta*, 1966, **13**, 154.
2. Nair, C. G. R., Joseph, T. and Joseph, P. T., *Chemist-Analyst*, 1965, **54**, 111.
3. — and Murthy, A. R. V., *Chemistry and Industry (London)*, 1962, p. 1539.
4. — and —, *Monatsh. für. Chem.*, 1963, **94**, 134.
5. — and —, *J. Sci. and Ind. Res. (India)*, 1962, **21 B**, 147.
6. Murthy, A. R. V., *Curr. Sci.*, 1953, **22**, 342.
7. Rao, V. R. S. and Murthy, A. R. V., *Talanta*, 1960, **4**, 206.
8. Mahadevappa, D. S., *Curr. Sci.*, 1965, **34**, 530.
9. Treadwell, F. P. and Hall, W. T., *Analytical Chemistry*, John Wiley, New York, 1958, **2**, 314.
10. Bishop, E. and Jennings, V. J., *Talanta*, 1958, **1**, 197.
11. Aravamudan, G. and Rao, V. R. S., *Ibid.*, 1964, **11**, 55.
12. Nair, C. G. R. and Murthy, A. R. V., *Proc. Ind. Acad. Sci.*, 1962, **55 A**, 168.

STRUCTURE-ACTION RELATIONSHIP OF PENICILLIN

A LARGE number of penicillins¹ with high antibacterial activity are now known and another antibiotic, namely, cephalosporin-C², resembling penicillin structurally and also in its mode of formation and action, has been added to this list. There is, however, no precise information in the literature about the structure-action relationship of penicillin. This aspect needed reconsideration and investigation as given below.

Penicillins are N-acylated-6-aminopenicillanic acid derivatives, the acyl function of which determines the nature and specificity of the drug, but it is not the only controlling factor of penicillin action. Antibacterial property of the antibiotic may be essentially due to (i) N-acyl β -lactam part or (ii) the other heterocyclic part or (iii) the fused bicyclic β -lactam disposition of the molecule. The stability of the ring systems, besides their stereospecificity deserves cognition, for it may influence the activity of penicillin at different pH, and under the enzymic offence of penicillinase.

With this background in mind the authors initially synthesised 3N-acylamino, 1, 4-diphenyl-2-azetidinone,³ ring substituted carbethoxy derivatives of β -lactams⁴ which are

reasonably stable towards alkali and N-acyl thiazolidine-4-carboxylic acid.⁴ These compounds have been tested against *Staphylococcus aureus* and *Escherichia coli* and their *in vitro* activity has been investigated using Penicillin G as the control, by the usual method.^{5a} The results were negative, and this finding is indicative of the fact that isolated β -lactams even though alkali stable do not possess antibacterial property, and so is the case with thiazolidine moiety. This statement is concordant with the earlier record that penicillin loses its activity when its β -lactam part is cleaved to give penicilloic acid, and also when its thiazolidine part is desulpharized to yield desthiobenzyl penicillin.⁵ⁱ It stipulates automatically that bicyclic β -lactam nature of penicillin is one of the essential factors for its antibacterial property. That penicillin is stereospecific in its action, has been observed by Sheehan and Logan.⁶ Thus antibacterial property of penicillin is embedded in its stereospecific fused bicyclic 6-amino β -lactam over which the acyl function has a steering effect, and this molecular disposition is essential for the interference with the microbial metabolism of the penicillin-susceptible organisms to bring about lysis of the cell wall of the developing microbes.

From the above considerations, it seems logical that stereospecific bicyclic β -lactam fused with heterocyclic moieties other than thiazolidine may be of some importance. This consideration stimulated the present authors to synthesise α -phthalimido-2-methyl oxazolidine-2-acetic acid β -lactam,⁷ and it remains to be studied whether any of its stereoisomers exhibit antibacterial property.

Chemistry Department, S. M. DESHPANDE.
Banaras Hindu University, A. K. MUKERJEE.
Varanasi-5, February 8, 1966.

1. Johnson, A. W., *Science Progress*, July 1964, **207**, 434.
2. Abraham, E. P. and Newton, G. G. F., *Emmencher*, 1961, **20**, 92.
3. Deshpande, S. M. and Mukerjee A. K., *Ind. J. Chem.* (in press).
4. — and —. Unpublished work.
- 5a. Clarke, H. T., Johnson, J. R. and Robinson, R., *The Chemistry of Penicillin*, Princeton University Press, Princeton, New Jersey, 1949, p. 1035.
- 5b. —, — and —, *Ibid.*, 1949, p. 256.
6. Sheehan, J. C. and Logan, H., *J. Amer. Chem. Soc.*, 1959, **81**, 3089.
7. Deshpande, S. M. and Mukerjee, A. K., "The synthesis of new bicyclic β -lactams," *J. Chem. Soc.* (accepted for publication).

ISOLATION OF 1, 2-DIMETHYL 4, 5-DIAMINO BENZENE IN A HETEROKARYON OF *ASPERGILLUS NIDULANS*

A PAIR of pteridine derivatives namely, 6, 7-dimethyl 8-ribityl lumazine and 6-methyl 7-hydroxy 8-ribityl lumazine, which were reported to be involved in riboflavine biosynthesis^{1,2} have been isolated in a heterokaryon of 2 non-allelic riboflavineless mutant of *Aspergillus nidulans* by Sadique et al.³ However, it has been reported by Radha and Shanmugasundaram⁴ that an isoalloxazine ring is formed by the condensation of a purine, uric acid with a benzenoid compound by the enzymes present in the mycelia of a riboflavineless mutant of *A. nidulans*. Hence, it was of interest to detect the benzenoid compound, 1, 2-dimethyl 4, 5-diamino benzene, an alleged precursor of riboflavine by Wolley.⁵ The present note deals with isolation of such a compound in a heterokaryon obtained by fusing 2 non-allelic riboflavineless mutants.

An established heterokaryon of 2 non-allelic riboflavineless mutants (*y* ribo₃ and *w* ribo₆) was produced and grown in a minimal medium for 10 days at 37° C.⁶ The mycelia were harvested and then homogenised with 95% ethanol containing 1% ammonia, in a cold room. The extract was centrifuged and the supernatant evaporated to a small volume at 3° to 4° C. in the cold room by preevaporation. The concentrated extract was adjusted to pH 4.0 by dilute acetic acid and chromatographed on florisil column.⁷ The column is first washed with water and the filtrate concentrated by preevaporation and when tested for any fluorescent spots by chromatography gave negative results. The florisil column was then eluted with pyridine-acetic acid mixture (10 : 1), followed by washing with water. The eluent was concentrated to near dryness and then chromatographed using butanol : acetic acid : water (4 : 1 : 5). The paper was examined under ultra-violet light, when a violet fluorescent spot with a R_f value 0.68 was obtained. This was eluted with dilute HCl and rechromatographed along with authentic sample of 1, 2-dimethyl 4, 5-diamino benzene, using the same solvent. It was interesting to note that both the test as well as authentic sample of 1, 2-dimethyl 4, 5-diamino benzene had same R_f values and the ultra-violet absorption spectra obtained, in a Unicam Recording Spectrophotometer (SP 700) of both had similar absorption characteristics, thus establishing the formation of 1, 2-dimethyl 4, 5-

diamino benzene in the heterokaryon of *A. nidulans*.

Univ. Biochem. J. SADIQUE.
Res. Dept., RADHA SHANMUGASUNDARAM.
Madras-25, E. R. B. SHANMUGASUNDARAM.
March 28, 1966.

1. Masuda, T., Kishi, T. and Asai, M. *Pharmacol. Bull. (Tokyo)*, 1957, 5, 598.
2. Molley, G. F. and Plaut, G. W. E., *J. biol. Chem.*, 1959, 241, 641.
3. Sadique, J., Radha Shanmugasundaram and Shanmugasundaram, E. R. B., *Naturwissenschaften* 1966, 53, 179.
4. Radha, K. and Shanmugasundaram, E. R. B., *Nature*, 1962, 193, 165.
5. Wolley, D. W., *Proc. Soc. Expt. Biol. and Med.*, 1950, 75, 745.
6. Pontecorvo, G., *Adv. Genetics*, 1953, 5, 14.
7. Asatoor, A. and Dalglish, C. E., *J. Chem. Soc.*, 1958, p. 1717.

SIALIC ACID IN THE GENITAL ORGANS OF THE MALE RAT

THE presence of sialic acid has been reported in the testis, seminal vesicle, prostate, semen and the spermatozoa of men, the concentration being particularly high in the vesicular secretion.^{1,2} The semen and spermatozoa of several other species of mammals (ram, bull, pig, dog and rabbit) have also been shown to contain this compound.³⁻⁶ In females, sialic acid has been demonstrated in the cervical mucus, follicular fluid and zona pellucida.^{4,7,8} The present communication is concerned with the distribution and concentration of sialic acid in the genital organs of the male rat.

Colony-bred young adult rats (130-150 gm.) of the Institute were used in this investigation. After removal, the tissues were blotted gently between pieces of filter-paper, weighed to the nearest 0.1 mg. in a Roller-Smith balance and then hydrolysed with 0.1 N H₂SO₄ for 1 hour at 80° C. The hydrolysate was adsorbed on to a Dowex 2 anion exchange resin (acetate form) column. Sialic acid was eluted from the resin column by acetate buffer (pH 4.6)³ and estimated directly after development of colour by Ehrlich's reagent.⁴ The readings were taken at 565 mμ in a Bausch and Lomb 'Spectronic 20' colorimeter.

It was possible to estimate sialic acid from individual testis but for the rest it was necessary to pool tissues from 5 rats for a single determination.

It will be evident from the results presented in Table I that the epididymis had a considerably higher concentration of sialic acid than the rest of the tissues (P < 0.01). The highest

TABLE I

The distribution of sialic acid in the genital organs of the male rat

Tissue	Sialic acid (Mg./gm.)
Testis (45)*	25.3† (21.2-30.7)
Caput epididymis (36)	61.3 (51.6-68.9)
Cauda epididymis (36)	80.8 (65.0-88.0)
Seminal vesicles (36)	25.6 (23.0-28.5)
Ventral prostate (36)	16.8 (12.6-22.7)

* No. of animals; † Mean with range in parenthesis.

value was recorded in the cauda epididymis ($P < 0.01$) and the lowest in the ventral prostate ($P < 0.01$). The testis and the seminal vesicles had virtually similar concentration of this compound.

The exact role of sialic acid in reproductive processes is unknown. It has been suggested that sialic acid may be involved in capacitation of spermatozoa⁶ and the fertilization process.⁸ The present finding on a high sialic acid concentration in the epididymis suggests a possible role of this compound in sperm maturation.

This investigation was supported by a grant from the Ford Foundation. Thanks are due to Dr. M. L. Dhar for his interest in this study.

Central Drug Research Institute,
Lucknow,
February 3, 1966.

A. R. BOSE.
AMIYA B. KAR.
P. R. DASGUPTA.

1. Odin, L., *Acta Chem. Scand.*, 1955, **9**, 1235.
2. Warren, L., *J. Clin. Invest.*, 1959, **38**, 755.
3. Svennerholm, L., *Acta Chem. Scand.*, 1958, **12**, 547.
4. Gottschalk, A., *The Chemistry and Biology of Sialic Acid and Related Substances*, Cambridge Univ. Press, 1960, p. 12.
5. Hudson, M. T., Wellerson, R. Jr. and Kupferberg, A. B., *J. Reprod. Fertl.*, 1965, **9**, 189.
6. Hartree, E. and Srivastava, P. N., *Ibid.*, 1965, **9**, 47.
7. Shivers, C. A., Metz, C. B. and Lutwak-Mann, C., *Ibid.*, 1964, **8**, 115.
8. Soupart, P. and Clewe, T. H., *Fertl. Sterl.*, 1965, **16**, 677.

TRANSAMINATION AND HEAT INCREMENT IN RUMINANTS

IN monogastric animals there is a high specific dynamic action of protein food^{1,2} depending on the extent of oxidative deamination associated with large heat increment and of transamination with a small heat increment.³ In ruminants, however, volatile fatty acids produced in the rumen are mainly responsible for the high heat

increment.^{4,5} administration of a mixture of volatile fatty acids in the rumen of a fasted sheep giving a much less heat increment than when the constituent acids were administered individually.^{6,7} It was thought desirable to investigate if transamination will play any role in the genesis of heat increment of feeding in ruminants like that of the monogastric animals. An attempt was made to study the rate of transamination reaction of the rumen content and its relation with heat increment of feeding in ruminants.

Transamination reaction of the strained rumen liquor⁸ and the oxygen consumption were studied with Benedict-Roth metabolism apparatus and Haldane gas analysis apparatus. Rumen fistulated sheep were maintained on 5 different feeds (low protein 6%; low protein and 5 gm urea; high protein 23% alone or along with 5 gm urea or with 30 gm casein).

TABLE I

Transaminase activity of strained rumen liquor (T) and increase in O₂ consumption percentage over the resting value (O₂)

	2 hrs. after feeding		6 hrs. after feeding	
	T	O ₂	T	O ₂
Low protein	.. 162.8	115.50	133.9	81.08
High protein	.. 231.6	19.91	188.2	18.51
Low protein+Urea	.. 168.3	98.33	20.96	79.85
High protein+Urea	.. 180.7	22.65	240.2	30.77
High protein+Casein	.. 371.4	38.74	209.8	42.09

Table I shows that in low protein feed a low transaminase activity in the rumen was correlated with a high oxygen consumption and in high protein diet a high transaminase activity in the rumen with a low oxygen consumption. When urea was added to the low protein diet the transaminase activity was increased and oxygen consumption was decreased correspondingly. Addition of urea or casein to a high protein feed led to a higher transaminase activity and presumably with considerable diamine activity associated with a high protein diet and thus the oxygen consumption, although lower than with low protein feed, was not proportionately so compared to the increase in transaminase activity. A lowering of heat increment with a high transaminase activity reflects the possible role of transamination in the genesis of heat increment of feeding in ruminants also.

The authors are grateful to the I.C.A.R. for the grant of the fellowship to one of us (A. R.).

Post-Graduate College of
Animal Sciences,
Indian Veterinary Res. Inst.,
Izatnagar, U.P., India,
February 11, 1966.

ABDUR REKIB.
D. P. SADHU.

1. Rubner, M., *Z. Biol.*, 1901, 42, 261.
2. Lusk, G., *J. Nutr.*, 1931, 3, 519.
3. Sadhu, D. P. and Brody, S., *Am. J. Physiol.*, 1947, 151, 342.
4. Benedict, F. G., *Vital Energetics*, Carnegie Inst. Wash. Pub. No. 503, 1938.
5. Marston, H. R., *J. roy. Soc. N.S.W.*, 1951, 84, 169.
6. Armstrong, D. G. and Blaxter, K. L., *Brit. J. Nutr.*, 1957, 11, 247.
7. Rekib, A., *Ph.D. Thesis*, Agra University, 1965.
8. Sall, T., Richards, H. K., Harrison, E. and Myerson, R. M., *J. Lab. and Clin. Med.*, 1957, 50, 295.

NOTES ON *NEITHEA MORRISI*, PICTET AND RENEVIER, FROM THE BAGH BEDS, MADHYA PRADESH

THE species *Neithea morrisi* described by Chipionkar (1939), from the Bagh Beds shows a wide range of variation in shell form and ornamentation that has so far been overlooked and its implications ignored. Some typical specimens comparable with Chipionkar's description are represented in the collection of the present authors. Other specimens make a continuous series in their form and ribbing pattern and, in all, four types can be differentiated.

Type A.—These specimens agree typically with the Aptian-Albian type of Pictet and Renevier. The shell is fan-like and a little higher than long. The ears are small and smooth except for faint growth-lines. The convex valve carries six convex, major radial ribs with two secondary ribs, in each of the interspaces, much smaller than the major ones. The major ribs are flanked by very fine thread-like costæ on either side.

Type B.—These specimens show striking affinity to the Aptian-Albian type of Pictet and Renevier, except that the fine thread-like costæ occur only on the sides of the major ribs away from the centre, that too being absent on the central interspace. The lateral areas on the convex valve carry fine riblets such as are found in the Japanese specimens (Nagao, 1934), though Woods (1903) says that in *N. morrisi* the areas are typically smooth.

Type C.—These specimens show close resemblance to *N. morrisi* except that the fine, thread-like costæ on either side of the major ribs are absent and the lateral areas carry fine riblets. The interspaces are less concave than

in the preceding types. The slightly inequilateral character and inequality of the ears are also points of distinction from its allies.

Type D.—In these specimens the contrast between the major and minor ribs is deciphered with difficulty. The shell is slightly inequilateral. The interspaces are more or less convex and there is no thread-like costæ on either side of the major ribs.

Thus the contrast between the major and minor ribs is variable when different specimens are studied. The number of thread-like costæ regularly vary with the curvature of the interspace, making the minor ribs more prominent at the cost of the finer costæ. Another striking relation is that, the less concave the interspace the less is the equilateral nature of the shell and equality of the ears. Collected from the same geological horizon, these constitute an interbreeding community, the regular variations in form and ornamentation being intraspecific rather than interspecific. Accordingly these specimens are grouped under *N. morrisi* and the original description is emended encompassing the variations.

Thanks are due to Prof. S. Deb for his interest in the present work and to Prof. K. C. Mitra for guidance. The authors are also indebted to Prof. P. Dutta for his kind help and instructions.

Department of Geology,
Jadavpur University,
Calcutta, February 4, 1966.

AJIT PAL,
SUBIR DUTTA.

1. Chipionkar, G. W., *Proc. Ind. Acad. Sci.*, 1939, 10 B (4).
2. Mirra, K. C., *Jour. Pal.*, 1958, 32.
3. Morris, G., *Catalogue of British Fossils*, 1854.
4. Nagao, T., *Jour. Facult. Sc. Hokkaido Imp. Univ.*, 1934, 2 (4), No. 3.
5. Woods, H., *Mon. Cret. Lam.*, 1903, 1.

OCCURRENCE OF PSEUDO QUARTZ VEINS IN THE GONDWANAS OF THE KANHAN VALLEY COAL FIELD, CHHINDWARA DISTRICT (M.P.)

THE Kanhan Valley forms a portion of the belt of coal fields occurring along the southern margin of the Satpura coal basin. The area occupies roughly thirteen square miles and lies between latitudes 22° 9' and 22° 12' N and longitudes 78° 28' and 78° 34' E. The area is drained by the river Kanhan and its feeder Takia Nala.

During the course of investigations in the area, the author came across certain quartz veins which are traversing the Talchirs and the Barakars along certain directions and which

have been thought as true quartz veins by Jones (1887, p. 53). From the study of these veins in the field as well as in laboratory, it appears that they are not normal cavity fillings as they have commonly been supposed. They are located along certain definite planes which are obviously fault planes. They do not show sharp contacts with the associated rocks. On the contrary they appear to merge into the sandstones (Talchir and the Barakar) which are partially crushed and recrystallised.

The rock type appears to be fine-grained, siliceous and whitish and consists of platy quartz lined up with hair-like cavities, filled with secondary silica. The cavities are oriented along the direction of the strike of the fault plane. Under microscope it is found to contain mostly the grains of quartz showing undulose extinction. The rock type shows variation in its texture and composition from place to place.

From the study of these veins in the field and under the microscope, it appears that their formation is largely governed by the following factors, namely (i) the nature of the sandstones involved in faulting, (ii) their granularity and susceptibility to crushing, granulation and recrystallisation, (iii) the magnitude of faulting and (iv) the nature of the movement during faulting.

They are mostly confined to the Talchir and the Barakar sandstones which are soft and fine-grained and more susceptible to crushing as compared to the Motur sandstones which are coarse-grained, gritty and compact. There appears to have been strike slip movement during the faulting as evidenced by the platy nature of the quartz and by the preferred orientation of the hair-like cavities. The effects of the strain to which the sandstones were subjected during faulting are further evidenced by the undulose extinction shown by almost all the constituent grains of the rock type.

To conclude, the so-called quartz veins are merely fault breccias, owing their origin to crushing, granulation and recrystallisation into thin platy vein-like mass.

Author is thankful to Prof. K. P. Rode for his guidance in the field and in the laboratory.

Geology Department,
University of Rajasthan,
Udaipur (Rajasthan),
February 8, 1966.

R. T. SHUKLA.

PRECAMBRIAN OROGENIC CYCLES AND TUNGSTEN METALLOGENY

METALLOGENY occurs in orogenic folded belts, generally localized within tectonic zones. The tectonic zones are to a large extent responsible for the zoning of ore belts in folded geosynclines (Smirnov, 1963). Tungsten, in metallogenic provinces, is generally associated with one or more of the metals like Au, Sn, Cb-Ta, Mo and Cu.

Tungsten mineralization related to Precambrian orogenies are known in Canada, Brazil, Norway, Egypt, Rwanda-Uganda belt, South Rhodesia, Transvaal, India and Northern Territory in Australia. The striking features are:

(i) The mineralization is in general of hypothermal quartz-tungsten vein-type with the only known exception of Paraiba and Rio Grande do Norte of Brazil which is of skarn-scheelite type.

(ii) The mineralization related to early orogenies (> 1000 m.y.) has dominantly quartz-scheelite veins with gold, the latter being apathetic to the former in general. Small amounts of sulfides may be present. Consequently, they form scheelite "mineralogenic province" in Canada and South Rhodesia. In India, scheelite is present with gold-quartz veins in Kolar Gold Field and its southern extension in Bisanattam related to Dharwar Cycle (2300 ± 100 m.y.).

Scheelite is probably present in large quantities where gold mineralization is meagre in quartz veins and has not been reported because of non-application of fluorescent method of prospecting in previous years. The zones of poor gold mineralization in rocks of Dharwar Orogeny in South India are good, prospective scheelite "mineralogenic provinces".

(iii) The mineralization in late Precambrian orogenies (< 1000 m.y.) is predominantly of quartz-wolframite (ferberite) veins, generally associated with cassiterite, gold and some sulfides; rarely Ta-Nb minerals. Wolframite (ferberite) "mineralogenic province" is found in Africa (Egypt, Rwanda-Uganda and Transvaal), Australia (Northern Territory) and in India (Satpura-Delhi orogenic belts).

The separation of wolframite and scheelite in distinctly different metallogenic provinces has been recognized and explained by Orlov (1962).

(iv) Generally, most of the quartz-tungsten veins are found within "folded belts" or in the contact zones with granitic intrusions. The association of the veins is mostly with sharply folded structures and related shear zones often

1. Jones, E. A., "The southern coal fields of Satpura Gondwana basin," *Mem. Geol. Surv. Ind.*, 1887, 24, pt. 1.

as elongated narrow belts. Many of such small belts have been recognized in African Precambrian rocks (De Kun, 1965).

It is noteworthy that hardly one per cent. of the world's production of tungsten is contributed by the mineralization related to granitic rocks of Precambrian orogenic cycles. Most of the production comes from the mineralization related to Hercynian and Nevadian-Laramide orogenies and even younger (Peru-Bolivian deposits). It is suggested that prospective tungsten mineralization should be searched for in Jammu and Kashmir and Himachal Pradesh where intrusions of Tertiary Granite are present.

Department of Geology, Y. G. DEKATE.
Visvesvaraya Regional College
of Engineering,

Nagpur, February 17, 1966.

1. De Kun, N., *The Mineral Resources of Africa*, Elsevier Publishing Co., Amsterdam, 1965, p. 473.
2. Orlov, K. Yu., *Relation between Scheelite, Wolframite and Sulfides*, DOK. Akad. Nauk., SSSR, (in Russian), 1962, 142, 207.
3. Smirnov, V. I., *Regional and Local Endogenous Ore Zoning*, Symp. Problems of Postmagmatic ore deposition, Praha (Published in 1965), 1963, 2, 35.

THE EFFECT OF B-NINE (N-DIMETHYL AMINO SUCCINAMIC ACID) ON THE SHOOT GROWTH OF CAJANUS CAJAN

CHEMICAL growth retardants have been used recently in dwarfing the plants¹ and the effect of B-Nine on the growth of horticultural

plants² has been reported. Little work has been done on the effect of B-Nine used in presowing treatments of seeds on the subsequent growth of crop plants, particularly the legumes. The experiment reported here was carried out to study the shoot growth inhibition of Arhar when the seeds were soaked in B-Nine prior to sowing.

Healthy and uniform seeds of the common Indian pulse *Cajanus cajan* (Varieties 17 and 21) obtained from the Economic Botanist (Legumes), Government of U.P., were used in this investigation. The seeds were soaked in 0.125% (T_1), 0.25% (T_2) and 0.50% (T_3) solution of B-Nine separately for 24 hours and after a thorough wash in distilled water the seeds were germinated in petri dishes containing two layers of filter-papers. The seeds soaked for the same duration in distilled water served as the control. The filter-papers were impregnated with distilled water from time to time. All treatments were replicated five times and arranged in randomised blocks on laboratory table under diffused light.

The most obvious effect of B-Nine on arhar is to cause a marked decrease in the height of the shoot. Figure 1 shows the inhibition of shoot growth on the six and nine-days-old seedlings at the highest concentration (T_3) of B-Nine. Higher concentrations exerted a progressively greater effect than the lower concentration. There was about 70% reduction in the length, fresh and dry weight of the shoot at the highest dose (T_3) of the chemical. The

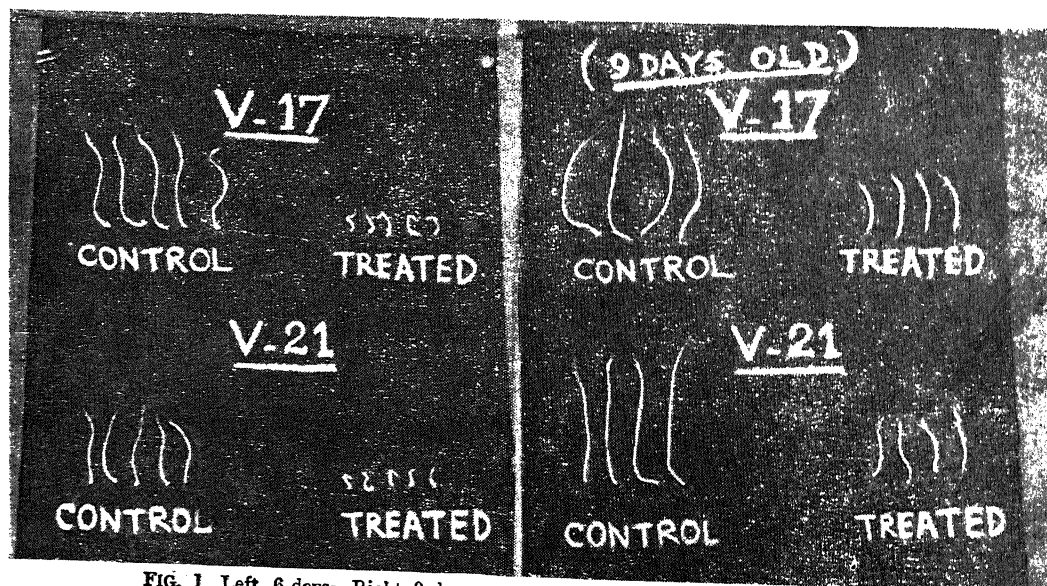


FIG. 1. Left, 6 days—Right, 9 days old Arhar shoot treated with 0.50% B-Nine

results obtained from analysis of variance of the data indicate that the variances due to treatment and to varieties were both highly significant ($P < 1\%$) and that the interaction between treatments and varieties was also significant ($P < 1\%$). The response indices³ (viz., mean daily growth rates expressed as a percentage of the growth rate of the untreated plants) concerning shoot elongation have been plotted against time in Fig. 2. While plotting the graph the assumption was made that the relative growth rates measured by the response indices were reached at a point in the time intermediate between each measurement. The measurements were made at 0, 5, 7 and 9 days and the response index attributed to 2.5, 6 and 8 days. Fig. 1 clearly shows the

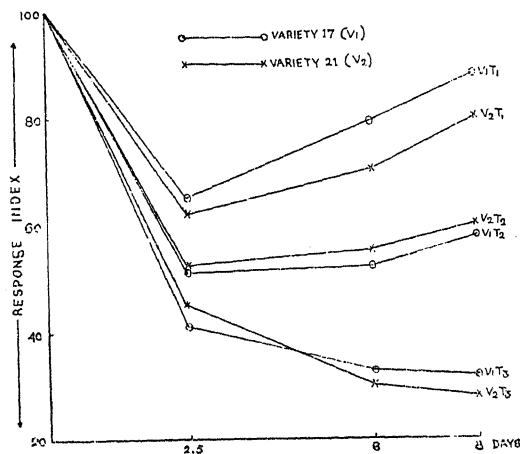


FIG. 2. Growth rate of Arhar treated with B-Nine related to that of untreated controls. Doses of B-Nine given to the right in the diagram (T_1 -0.125%, T_2 -0.25% and T_3 -0.50% of B-Nine).

inhibition on shoot elongation due to the treatments with the chemical. The changes in the levels of weight accumulation of shoot for the treated series were very significant ($P < 1\%$). Treatment with B-Nine produced a significantly progressive decrease in the increments of the both fresh and dry weight of the shoot, with the increase in the concentration. Calculation from the actual dry weight of plants, on the top-to-root ratio showed that this ratio decreased gradually with increase in the concentrations of B-Nine as the days advanced. As regards the varietal difference, the variety 21 was better responsive to the chemical than the variety 17.

It is concluded that B-Nine at the highest concentration (0.50%) is definitely inhibitory for the shoot growth of arhar. The cause of the retardation in the shoot elongation of the

treated plants may be due to an inhibition of cell division or a reduction in the number of cells.⁴

We are thankful to Naugatuck Chemical Division, United States Rubber Company, Naugatuck, Conn., U.S.A., for providing the sample of B-Nine used in this investigation.

Department of Botany, D. MISHRA.
Utkal Krushi Mahavidyalaya, S. K. MOHANTY.
Orissa Univ. Agric. & Tech.,
Bhubaneswar-3, January 30, 1966.

1. Cathey, H. M., *Ann. Rev. Plant Physiol.* 1964, **15**, 271.
2. —, *Flor. Rev.*, 1963 **35**, 132 (3426), 81.
3. Brian, P. W. and Hemming, H. G., *Physiol. Planta.*, 1955, **8**, 669.
4. Sachs, R. M., Lang, A., Bertz, C. F. and Roach J., *Amer. J. Bot.*, 1960, **47**, 260.

STUDY OF FOSSIL DISTORTION CAUSED BY TECTONIC DEFORMATION IN THE KASHMIR HIMALAYAS (LIDDAR VALLEY)

FOSSILS in deformed rocks can be of greater service than pebbles in the determination of the amount and direction of rock deformation. Among the fossils the brachiopods are more suited for the purpose than pelecypods as the former are more symmetrical, where the plane of symmetry lies at right angles to the hinge line and passes evenly through the two valves. Before any rock deformation took place, the plane of symmetry and the hinge line of individual brachiopod shells would make a right angle on the bedding plane and as a result of deformation the right angle is changed; the amount of change depends on the direction that the right angle faces and on the amount of rock deformation.

In the present study the distortion caused to the brachiopods of different genera embedded in an oriented specimen of Fenestella Shale collected from the Liddar Valley (locality: near Yanar, Sheet No. 43 0/5, Lat. $33^{\circ} 51'$; Long. $75^{\circ} 17'$) has been analysed. The bedding plane strikes 300° - 120° and dip is 10° northerly. A slab of rock about 23 cm. long (Fig. 1) contained eight useful single brachiopod shells. The plane of separation of the valves is parallel to bedding for the eight shells. The hinge line of each shell is still straight and it is assumed that all lines that were originally straight remained straight during deformation and are still straight, the type of deformation is "homogeneous". The direction of the hinge lines and the lines of intersection of the planes of symmetry and bedding planes were trans-

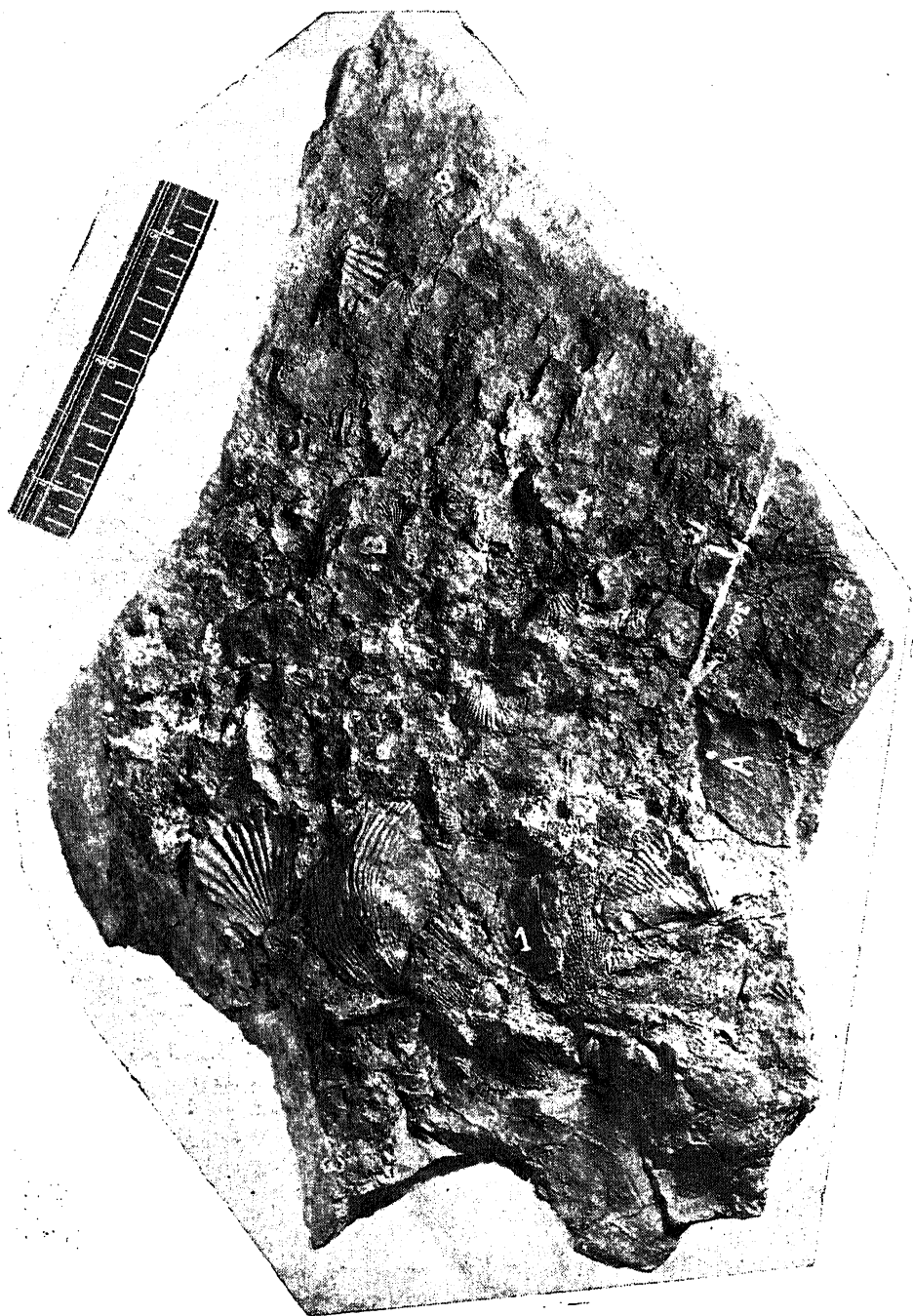


FIG. 1. An oriented specimen of Feneštella Shale (Middle Carboniferous) from the Liddar Valley, Kashmir, India, enclosing distorted brachiopods.

ferred to paper from the slab of rock; this was done very accurately by projecting them upon to a sheet of glass held parallel to the bedding plane. Two arbitrary points A and B were

marked on the same plane as the line. These two points were 7 cm. apart. Each fossil furnished two lines. Next, lines were drawn through each of the two arbitrary points parallel

to the two lines of each fossil and the two intersections were marked, making sixteen points in total. An ellipse was next constructed with its circumference as close as possible to the sixteen points.

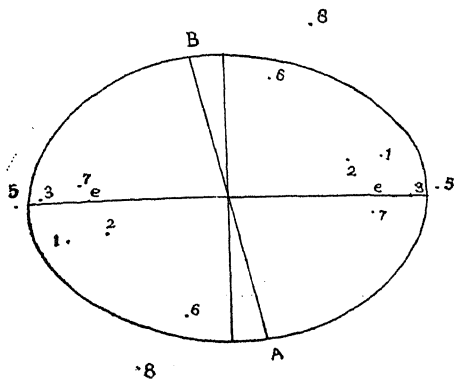


FIG. 2. Ellipse defined by points given by fossils. Apparent shortening ratio: 0.70 to 1.

The short axis of the ellipse drawn is parallel to the direction of apparent shortening and the direction at right angle to this line gives the direction of apparent lengthening. The ratio of the two axes of the ellipse, which is 0.70 to 1, is the shortening ratio and the direction of the apparent shortening is approximately 50° – 240° (NE–SW).

While writing this paper, the author has followed H. W. Wellman's "A graphical method

for analysing fossil distortions caused by tectonic deformation" [Geol. Mag., 99 (4), pp. 348–52]. Grateful acknowledgments of the author are also due to the Director-General, Geological Survey of India, Calcutta-13, and to Dr. A. K. Saha, Professor of Geology, Presidency College, Calcutta.

Palaeontology Lab.,
33/4, B.M. Lane,

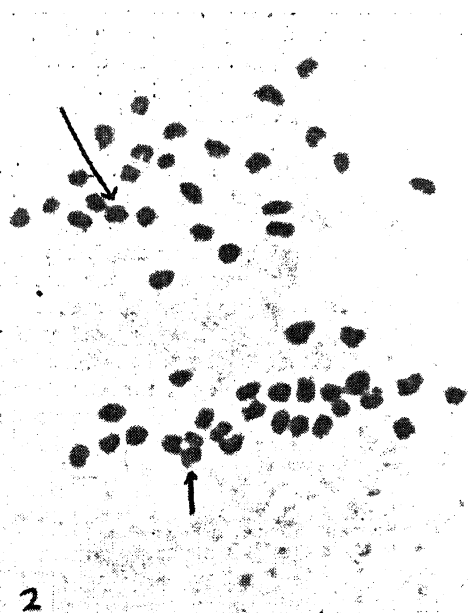
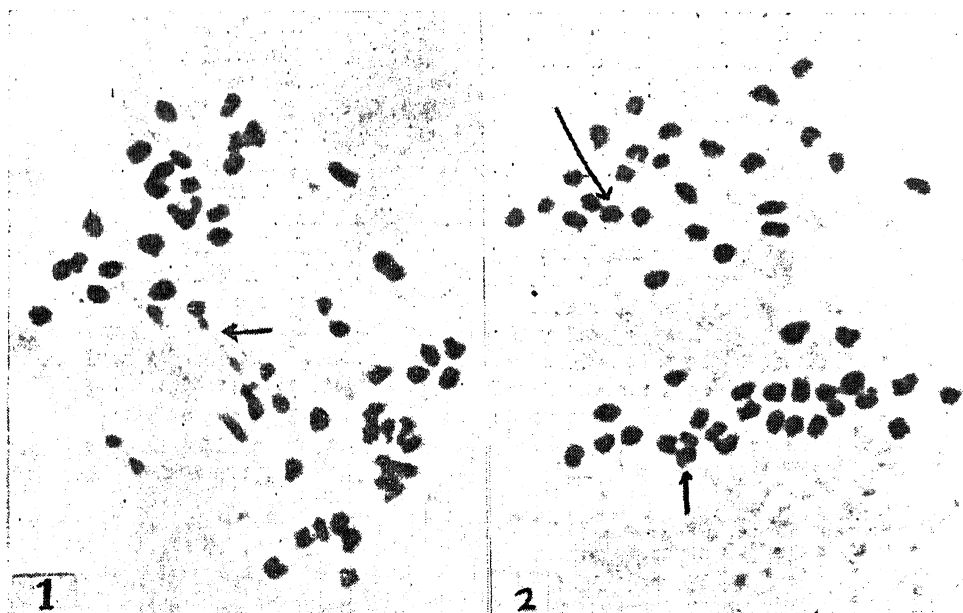
SATYA S. SARKAR.

Howrah (W.B.), January 21, 1965.

PRELIMINARY MEIOTIC STUDY IN *PENNISETUM PEDICELLATUM* TRIN.

Pennisetum pedicellatum Trin. is a grass of acknowledged forage value.¹ The grass belongs to the tribe Paniceae of the family Gramineae. Nath and Swaminathan² recorded 54 as $2n$ chromosome number in the Australian variety of this grass. The preliminary meiotic study confirms the somatic number recorded as above. In this note certain interesting observations in the form of multivalents, chromosomal bridges, lagging chromosomes, unequal disjunction of chromosomes have been recorded.

Invariably one hexavalent has been observed in each P.M.C. Besides, the hexavalent, one quadrivalent, nineteen bivalents and six univalents are a common feature. Meiotic studies in *P. pedicellatum* reveals it to be heterozygote for inversion resulting in the formation of chromatid bridges (Fig. 1). Laggards



FIGS. 1-2. Meiotic chromosomes of *Pennisetum pedicellatum* Trin. Fig. 1. Anaphase I—showing two bridges, 4 bivalents lagging. Fig. 2. Anaphase I—showing unequal disjunction of chromosomes (26:28) and one trivalent seen on each pole.

are frequently seen, their number varies from 2 to 4 (Fig. 1). In about 40% cases there is unequal disjunction of chromosomes and a trivalent is seen at each pole (Fig. 2). The second division also shows lagging chromosomes. Pollen viability is about 80%.

The above-mentioned irregularity suggests the plant to be a segmental allohexaploid. The low frequency of multivalents is suggestive of genome differentiation.

The authors wish to express their grateful thanks to U.G.C. for financial assistance.

Botany Department, S. P. NAIETHANI,
University of Allahabad, K. P. SISODIA.
Allahabad, January 16, 1966.

1. Bor, N. L., *The Grasses of Burma, Ceylon, India and Pakistan*, (excluding Bambuseae), Pergamon Press, Oxford, 1960.
2. Nair, J. and Swaminathan, M. S., "Chromosome numbers of some grasses," *Ind. Jour. of Genet. and Pl. Breed.*, 1957, 17, 107.

ANIMAL FOSSIL AND EARLY STONE AGE TOOLS FROM GANGAPUR ON THE GODAVARI RIVER (NASIK DIST., MAHARASHTRA STATE)

AMONGST the several sites yielding Early Stone Age artefacts in the Godavari drainage area, including the valleys of its tributaries like the Pravara, are the localities near Gangapur village, about 10 km. NW of Nasik. From the stratified deposits of gravel, sand, and clays exposed hereabouts, during the construction of an earthen dam in 1951, Dr. Sankalia¹ discovered Early palaeolithic tools, consisting of handaxes, cleavers, scrapers and flakes made of the basalt rock (Deccan Trap). Practically all the artefacts were obtained from the gravel conglomerate, or at its junction with the sands and clays. No fossil was, however, found in these deposits. In fact, the only known fossil-bearing localities on this river near Gangapur are at Nandur-Madhmeshwar situated at the confluence of the Godavari and the Kadva approximately 50 km. east of Nasik.² Even at Nandur-Madhmeshwar the fossils have been mostly found in the river-bed. Besides, no early palaeolithic implement has been reported from this area, the tools found here being of Middle and Late Stone Ages.

In 1956 Sovani³ re-examined the river between Gangapur and Eklahre for a stretch of 25 km. The only site yielding early palaeoliths was in the river section near Gangapur. His collection of twelve specimens, comprising handaxes, cleavers, and flakes, was obtained

from the coarse pebbly conglomerate resting on the trap rock and covered by another gravel and silt. The artefacts were of advanced type similar to those from Nevasa on the same river.

In a short visit to the Gangapur site in December, 1965, the present authors examined a part of the right bank of the Godavari River for about 200 m. The section close to the river had exposed weathered trap rock at the base overlain successively by red clay, gravel, sand, brown clay, and black soil. From the junction of the gravel bed and the underlying clay sand half a dozen palaeoliths were extracted. It was from the same horizon that a thoroughly mineralised fragmentary mandible of *Bos namadicus* was obtained (Fig. 1). The fossil

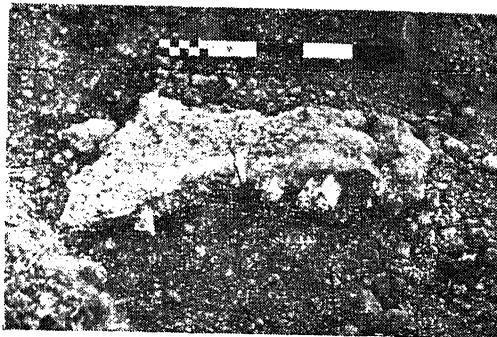


FIG. 1. Fragmentary mandible of *Bos*.

was completely embedded in the gravel. This was the first time an animal fossil along with the Early Stone Age artefacts has been found in the upper Godavari valley. This fossil, on the parallel evidence from the Narmada, may denote Middle Pleistocene horizon for the tool-bearing gravel. The entire palaeolithic collection consists of six cleavers, twelve flakes and three scrapers. The artefacts show advanced Acheulian forms.

The unrolled character of the tools and the fossil and their juxtaposition in the same layer shows that they are in their original site and have not undergone any transportation and hence are mostly undisplaced from their original place of deposition.

Archaeological Survey R. V. JOSHI.
of India, Prehistory Branch, S. A. SALI.
Nagpur-1, February 8, 1966. B. P. BOPARDIKAR.

1. Sankalia, H. D., *The Godavari Palaeolithic Industry*, Poona, 1952.
2. *Mgsi*, 6, p. 232 and *Rgsi*, 32, pp. 199-202; and Sankalia, H. D., "Studies in the Prehistory of the Deccan, A Survey of the Godavari," *BDCRI*, 1944, 4, 186.
3. *Indian Archaeology 1956-57—A Review*, p. 11. Also see *Indian Archaeology 1959-60—A Review*, p. 29.

REVIEWS AND NOTICES OF BOOKS

The Organization of Research Establishments.

Edited by Sir John Cockcroft. (Cambridge University Press, New York and London), 1965. Pp. 275. Price \$ 11.50 in U.S.A. and 63 sh. net in U.K.

In this book, the heads of several research establishments discuss the problems involved in organizing research in a wide variety of fields, ranging from physics to psychiatry, and from agriculture to technology and transport. Government establishments, international research organizations, nationalized industries, co-operative research associations and private industrial firms are all represented.

An introduction by Sir John Cockcroft sets the individual contributions in perspective and a concluding chapter by Sir Edward Bullard (formerly Director of the National Physical Laboratory) attempts to answer the question of 'What makes a good research establishment?'.

Among the obvious factors which make for or detract from creativity and productivity in research are the wise choice of problems to be worked on, the selection and promotion of staff (technical and administrative as well as scientific), their relations with each other, their morale, and the facilities available to them. The principles which should determine the selection of research problems to be worked on are very different in pure research, where the advancement of knowledge is the main motive, and in industrial research, where economic benefits are the objective. The application of these principles is discussed in this authoritative work by 15 experienced Directors of Research.

C. V. R.

Quantum Mechanics and Path Integrals (*International Series in Pure and Applied Physics*).

By Richard P. Feynman and Albert R. Hibbs. (McGraw-Hill Book Company Inc., New York), 1965. Pp. xiv + 365. Price \$ 12.50.

This book is intended (1) to supplement a first-year course in quantum mechanics; (2) to enable physicists already acquainted with more traditional approaches to quantum mechanics to enlarge their familiarity with this subject; and (3) to provide a source book for the path integral techniques developed by R. P. Feynman.

The approach is primarily intuitive and relies on the so-called "path integral method" deve-

loped originally by the senior author. This method is most powerful when applied to a particular set of quantum mechanical problems, such as the scattering of an electron in a potential field, or various perturbation problems. The authors concentrate on those problems where this approach is most powerful and, while showing the connection between the path integral approach and the Schroedinger wave equation technique, do not treat those aspects of the subject which are best treated by the wave equation method. In this sense, the book is a supplement to existing texts in quantum mechanics.

C. V. R.

Physical Acoustics (Vol. III, Part B: *Lattice Dynamics*).

Edited by W. P. Mason. (Academic Press, New York and London), 1965. Pp. xix + 336. Price \$ 12.00.

This volume covers the application of normal waves in solids to the study of lattice dynamics.

In the course of this book techniques are discussed for obtaining the Debye temperature of crystalline and sintered materials through the use of their elastic constants. Also discussed are the interactions of acoustic waves with spin waves, and the effect of saturation magnetic fields on the domains in solids.

The relation between sound velocities, densities, and molecular weights are considered and used in determining the repulsive and attractive components of the force laws. In the case of oxides, which make up most of the Earth's crust, a particularly simple relation is found which accounts for the single pressure-velocity relation obtained from seismological data.

Information is presented on the improvements of synthetic quartz that can evolve through the study of imperfect motions, on the effect of light on dislocation damping, and on seismological damping mechanisms.

C. V. R.

Wet Combustion and Catalytic Methods in Microanalysis. (*Method in Microanalysis Series: Vol. 2*). Edited by J. A. Kuck. (Gordon and Breach, Science Publishers, 150, Fifth Avenue, New York), 1966. Pp. xx + 412. Price \$ 21.00.

Volume II of the series *Methods in Microanalysis* presents further essential material on

the subject of organic microanalysis consisting of selected translations of significant articles that have appeared in recent Russian and Czechoslovak research journals.

Special attention has been given to the work of Alexander P. Terent'ev of Moscow University who has developed a successful technique of wet combustion for the analysis of refractory substances such as organo-metallic polymers and compounds with various N, P and Si combinations. Twelve papers are devoted to this work alone; they contain some excellent practical analytical chemistry. The book includes other contributions by Professor Terent'ev and his co-workers; viz., the practical substitution of magnesium, calcium or magnesium nitride for the traditional sodium fusion, and comparative studies in both microhydrogenation and the determination of active hydrogen.

The book also presents valuable detail and useful laboratory directions relating to catalytic oxidation and reduction in organic microanalysis. Two important oxidation catalysts are extensively discussed: chromium sesquioxide and the "decomposition product" of silver permanganate. In regard to the latter, the book features research work by the noted Czech microanalyst, Jiri Körbl, of the Analytical Department of the Research Institute for Pharmacy and Biochemistry in Prague. He has published extensively on the structure, properties, and application of the curious material from silver permanganate which operates as a very active catalyst in the micro-combustion.

C. V. R.

Advances in Virus Research (Vol. XI). Edited by K. M. Smith and M. Lauffer. (Academic Press, New York and London), 1965. Pp. ix + 425. Price \$14.50.

The contents of this volume are as follows: Gross Morphology and Serology as a Basis for Classification of Elongated Plant Viruses, by J. Brandes and R. Bercks; Artificial Production of Mutants of Tobacco Mosaic Virus, by Albert Siegel; Plant Virus-Vector Relationships, by Kenneth M. Smith; Mite Transmission of Plant Viruses, by J. T. Slykhuis; Genetics of Pathogenicity in Viruses and of Resistance in Host Plants; by Francis O. Holmes; Introduction, Translocation and Distribution of Viruses in Plants, by Irving R. Schneider; The Antigenic Structure of Tobacco Mosaic Virus, by Irving Rappaport; Arthropod Transmission of Animal Viruses, by Herbert S. Hurlbut; Avian Tumor Viruses, by Peter K. Vogt.

C. V. R.

Advances in Food Research (Vol. 14). Edited by C. O. Chichester, E. M. Mrak and G. F. Stewart. (Academic Press, New York and London), 1965. Pp. viii + 464. Price \$16.00.

The present volume under review contains the following articles: Techniques for Sensory Evaluation of Food Odors, by Herbert Stone, Rose Marie Pangborn and C. S. Ough; Methods of Meat Texture Measurement Viewed from the Background of Factors Affecting Tenderness, by Alina Surmacka Szczesniak and Kathryn Weiss Torgeson; Chemistry of Non-enzymic Browning II, by T. M. Reynolds; Unimolecular Thermal Transformations of Organic Compounds under Food Processing Conditions, by Jack W. Ralls; Theory and Practice of Hard-Surface Cleaning, by Walter G. Jennings.

C. V. R.

Advances in Carbohydrate Chemistry (Vol. 19).

Edited by M. L. Wolfrom. (Academic Press, Inc., New York), 1964. Pp. xi + 413. Price \$15.00.

The first four chapters of this volume are devoted to four modern instrumental techniques as applied to carbohydrate studies. They are: Crystal Structure Analysis, by G. A. Jeffrey and R. D. Rosenstein (Pittsburgh); Infra-red Spectroscopy, by H. Spedding (Alberta); Nuclear Magnetic Resonance, by L. D. Hall (Ottawa); and Gas-Liquid Chromatography, by C. T. Bishop (Ontario). Modern reaction mechanisms involving carbohydrate structures are discussed in the next three chapters. G. J. Moody (Cardiff) deals with the action of hydrogen peroxide on carbohydrates and related compounds; E. F. L. J. Anet (Australia) reviews the part played by 3-deoxyglycosuloses and their anolic forms, and by unsaturated glycosuloses, in the degradation of carbohydrates, and D. M. Jones (Manchester) deals with recent aspects of the determination of the structure and reactivity of cellulose. T. E. Timell (Syracuse) reviews in detail the structures and properties of all wood hemicelluloses. Part I of this article appears in this volume while Part II will appear in next volume. The final article in the volume is on the pneumococcal polysaccharides by M. J. How, J. S. Brimacombe, and M. Stacey (Birmingham). The advent of several antibiotic substances, which provide effective treatment for pneumonia, has in no way diminished the interest shown earlier in the pneumococcal polysaccharides. The article brings up to date the developments in this field emphasizing the value of immuno-

logical techniques in determining the structure of polysaccharides.

The volume opens with an obituary of Dr. Alva Thompson by D. Horton. A.S.G.

The Oligosaccharides. By J. Stanek, M. Cerny and J. Pacak. (Academic Press, Inc., 111, Fifth Avenue, New York), 1965. Pp. 567. Price \$21.00.

The present monograph is a companion volume to the one on Monosaccharides published earlier. An oligosaccharide may be defined as a compound which, on complete hydrolysis, gives one or more monosaccharides per molecule (Greek *oligo*, a few). Most frequently encountered are the disaccharides and the trisaccharides, and less common are the tetra, penta and hexasaccharides. During the last few years there has been an increased volume of work on oligosaccharides as a result of well-known modern methods of isolation and identification, especially chromatographic methods. Quite a large number of oligosaccharides have been obtained both from natural materials and by synthetic methods. The chemistry of oligosaccharides and their derivatives is a subject of growing interest, and the present monograph, perhaps the first comprehensive book on the subject, will be widely welcomed.

The original Czech edition of the book was published in 1962, and the present English edition is not a mere translation of it, but a new edition which incorporates recent developments and brings the references to as late as 1964. A. S. G.

The Technology of Fish Utilization (International Symposium). [Fishing News (Books) Ltd., 110 Fleet Street, London, E.C. 4], 1965. Pp. 280 (21 × 30 cm.). Price £5-5 sh.

Fish occupies an exceptional position in human nutrition. It contains high quality protein, almost all vitamins and essential fatty acids, minerals and trace elements including iodine and fluorine. Use of fish in nutrition holds exciting possibilities for the future. With the grim forboding of a doubling of the world's population in the next 3 or 4 decades, man has to look for his sustenance to the vast reserves of the oceans. International co-ordination is essential to meet this challenge.

In this context the United Nation's Food and Agriculture Organization (FAO) organized a Symposium on the "Significance of Fundamental Research in the Utilization of Fish". It was held in May 1964 at Husum, a small town in

northern Federal Republic of Germany. About 90 scientists and technologists, representing 21 countries, reviewed and discussed 60 original research contributions relating to fish preservation and methods of improving the same. The symposium focused attention on what the fishing industry wants and what basic research can contribute, now and in the near future, in vital problems connected with fish preservation.

The volume under review, which is a compilation, carefully edited by Dr. Rudolf Kreuzer, of the papers and discussions, will be highly useful as providing working foundation for future progress in this important field of scientific activity.

A. S. G.

The Fungi (An Advanced Treatise) (Vol. 1: *The Fungal Cell*). Edited by G. C. Ainsworth and Alfred S. Sussman. (Academic Press, Inc., 111, Fifth Avenue, New York), 1965. Pp. 748. Price \$24; Subscription Price \$19.50.

Fungi play an essential part in the economy of nature and profoundly affect human affairs. The biochemical aspect of fungal activity, especially connected with fermentation, gave impetus to studies on fungi. The use of fungi as chemical tools in analysis is now a commonplace. *Aspergillus niger* is used to determine traces of iron and copper in soils, and vitamin B can be assayed by means of *Ashbya gossypii*. Researches on fungi have led to phenomenal developments in antibiotics. Even geneticists are taking advantage of the short life-cycle of fungi to elucidate problems of genetics.

The Academic Press new publication—the three-volume treatise on fungi—is designed to provide a critical and modern survey of a group of fungal organisms that are important to basic and applied biology. The work on fungi has become so specialised, and the literature on fungi has so much grown that it is impossible for a single author to succeed in presenting an acceptable and balanced review of the subject in range and depth. In the preparation of this treatise specialists have been invited to contribute on the diverse aspects of fungal research. The first volume deals with fungi at the cellular level. The two succeeding volumes will be devoted to fungus organism and fungal populations.

Twenty-nine authors have contributed an equal number of chapters to the first volume. The book is divided into four sections. In the First Section Introduction, Ainsworth gives

a historical introduction to mycology, and Hickman gives a general review on fungal structure and organization. Section Two on *Cell Components* contains chapters on cell wall, flagella, ultrastructure, mitosis, meiosis, chemical constituents, utilization of inorganic nitrogen compounds and amino-acids, and integration of cellular metabolism. Section Three on *Nutrition and Growth of Cells* contains articles on uptake and translocation, chemical environment for fungal growth, kinetics of fungal growth, the mechanism of cellular extension and branching, growth rhythms, and synchrony and chemostasis. Section Four is on *Gene Action*.

A. S. G.

The Method of Averaging Functional Corrections: Theory and Applications. By A. Yu. Luchka. (Academic Press, New York and London), 1965. Pp. xvii + 134. Price: Paperback \$3.45, Clothbound \$6.50.

Contemporary developments in science and technology have enlarged the field of application of mathematics and there has become increasing need for the development of approximate methods of solution of various mathematical problems. The book under review is devoted to investigations and generalizations of a new method of finding approximate solutions of integral, differential, integrodifferential and other types of equations. The method first suggested by Yu. D. Sokolov has come to be known as "the method of averaging functional corrections". In this English version of the book, first published in Russian, the author after giving the general theory of the method discusses its applications to linear integrodifferential equations, to systems of integral and differential equations, and to systems of linear algebraical equations. The effectiveness of the method is illustrated in each chapter by a number of examples.

A. S. G.

The Elements of Chemistry. By Antoine Lavoisier. (Dover Publication, Inc., 180, Varick Street, New York 14). Pp. xxxi + 1 + 511. Price \$3.00.

The latest to be added to the Dover enterprise of issuing in inexpensive paperbacks classical works of great scientists is the one *The Elements of Chemistry* by Lavoisier. This is a facsimile of the publication "The Elements of Chemistry, in a new systematic order, containing all modern

discoveries" which is an English translation (Edinburgh, 1790) by Robert Kerr of the classic French work "Traite elementaire de Chimie" by Antoine-Laurent Lavoisier (Paris, 1789). Professor Douglas McKie has written an Introduction to the Dover edition which contains a short biography of Lavoisier, and an informative survey of historical developments in chemistry which provides the background for Lavoisier's work. The book includes 13 double page plates, 2 charts, and a fold out.

A. S. G.

Books Received

Advances in Food Research (Vol. 14). Edited by C. O. Chichester, E. M. Mrak and G. F. Stewart. (Academic Press, New York), 1965. Pp. viii + 464. Price \$6.00.

Advances in Virus Research (Vol. 11). Edited by K. M. Smith and M. A. Lauffer. (Academic Press, New York), 1965. Pp. ix + 425. Price \$14.50.

Physical Acoustics Principles and Methods (Vol. III, Part B: *Lattice Dynamics*). Edited by W. P. Mason. (Academic Press, New York), 1965. Pp. xix + 336. Price \$12.00.

Semiconductor Devices. By J. J. Brophy. (George Allen and Unwin Ltd., Ruskin House, 40, Museum Street, London W.C. 1), 1966. Pp. viii + 130. Price 18 sh.

Proceedings of the Symposium on Bacterial Transformation and Bacterio Cinogeny. (Akademiai Kiado Publishing House, The Hungarian Academy of Science, Budapest V, Alkotmany u. 21), 1967. Price \$6.00.

Documentation Research and Training Centre—Annual Seminar—3, Depth Classification Subject Heading. (Indian Statistical Institute, DRTC, 112, 11th Cross, Malleswaram, Bangalore-3), 1965. Pp. 569.

The Organisation of Research Establishments. Edited by Sir John Cockcroft. (Cambridge University Press, London), 1965. Pp. 275. Price 63 sh.

High Energy Nuclear Reactions. By A. B. Clegg. (Clarendon Press, Oxford), 1965. Pp. vi + 130. Price 18 sh.

Transition Metal Chemistry. Edited by R. L. Carlin. (Marcel Dekker, Inc., 95, Madison Avenue, New York 10016), 1965. Pp. xi + 307. Price \$12.75.

Social Insect Populations. By M. V. Brian. (Academic Press, Inc., Berkeley Square, London W. 1), 1965. Pp. vii + 135. Price 35 sh.

MASS SPECTROMETRY AND ITS APPLICATIONS TO ORGANIC CHEMISTRY*

THE beginnings of mass spectrometry may be traced back to the technique of positive ray analysis by the "parabola method" developed by J. J. Thomson in 1910. This was followed by the construction of the early mass spectrograph by Aston and improvements on it by Dempster and Bainbridge which led to the pioneering work on the determination of isotopes of elements. During the past two decades the field of application of mass spectrometry has enlarged rapidly, and especially in organic chemistry its use has gone beyond its recognized service to the Petroleum Industry. It has now become an adjunct tool for organic structure analysis.

This development and expansion of the field of mass spectrometry is due to many factors, such as the natural tendency, as in other fields, to develop the most sophisticated apparatus possible and the availability of resources to do this. In the past the research worker in mass spectrometry was intimately involved with the apparatus and technique. Now, as is the case in many other disciplines also, a new type of research worker is beginning to acquire mass-spectrometry apparatus. He is not concerned with the intricacies of the apparatus, but only wishes "to inject a bit of material into its inlet and have as completely reduced data as possible emerge from its recorder as quickly and as accurately as possible".

While this has helped rapid progress being made in the concerned field of study in instrumentation, technique and area of application, it has also created a gap between those whose pioneering efforts have contributed to this progress and those who use these instruments and technique for further studies of a routine nature. The NATO Advanced Study Institute had for its object a narrowing of this gap in the field of Mass Spectrometry.

The Study Institute was held at the University of Glasgow in August 1964. It brought together two classes of workers: (1) working scientists from many countries who have made significant contributions in the field and can

speak with authority on the special subject of their investigations and (2) those who as students attended the lectures and the practical classes and participated in the seminars. Although the course was essentially a practical one, the experiments being mainly organic chemical in character, the lectures included theory, design and applications in which each contributor made a balanced assessment of his particular area of study. At a time when the subject is developing so rapidly and in so many ways, this permanent record of the lectures at the Advanced Study Institute, displaying considerable scholarship and incorporating latest references and results is sure to appeal, besides the participants, to the wider field of interested workers.

The following are the titles and the names of authors of some of the contributions selected at random: Mass spectrometry design—Magnetic deflection instruments, by G. A. Errock; Radio-frequency mass spectrometers and their application, by C. Brunnee; Advances in Time-of-flight mass spectrometry, by D. C. Damoth; Field ion mass spectra of organic molecules, by H. D. Beckey; The Quasi-equilibrium theory of mass spectra, by R. M. Sathe; Electronic aspects of the structure and mass spectra of large ring systems, by G. R. Lester; Mass spectrometry of volatile inorganic compounds by H. J. Svec; Mass spectrometer studies of heterogeneous chemical kinetics, by A. Pentenero and Pierre Le Goff; Modern trends in the mass spectrometry of organic compounds, by J. H. Beynon.

Applications of Mass Spectrometry to Organic Chemistry may be considered as an appropriate companion volume to the one reviewed above. The analysis of the mass spectrum obtained from an organic polyatomic molecule is still a formidable problem. The peculiar difficulty of this spectrum is that it is so rich in information that, in the present state of the subject, one is not able to make the fullest use of it. For a given polyatomic molecule there is an ion in the spectrum corresponding to nearly every possible fragmentation—primary, secondary, metastable, re-arrangement ions, etc.

The present trend of study follows two main lines: Attempts are being made to deduce the structure of the molecule from the observed mass spectrum, and, conversely, a *rationale* is provided for the fragmentation pattern of a known structure. Prof. Reed's book emphasises these lines of approach.

* *Mass Spectrometry*—A NATO Advanced Study Institute on Theory, Design and Applications. Edited by R. I. Reed. (Academic Press, London and New York), 1965. Pp. 463. Price 105 sh.

Applications of Mass Spectrometry to Organic Chemistry. By R. I. Reed. (Academic Press, Inc., London and New York), 1966. Pp. ix+256. Price: 63 sh.

RAMAN AND INFRARED SPECTRA OF SOME AMIDES

K. VENKATA RAMIAH, V. VENKATA CHALAPATHI AND Miss C. A. INDIRA CHARY

Department of Physics, University College of Science, Osmania University, Hyderabad-7 (A.P.)

MIYAZAWA *et al.*,¹ Lumley Jones,² and Venkata Ramiah *et al.*³ studied the Raman and infrared spectra of some secondary and tertiary amides and assigned the vibrational frequencies. Recently Beer *et al.*⁴ have studied the infrared spectra of some substituted amides and of their deuterated species. In this note, we report the Raman and infrared frequencies of N-methyl propionamide, N-N dimethylpropionamide and discuss the vibrational frequencies of the functional groups of propionamide and its N-N deuterated amide. The infrared spectra of these compounds and their solutions were recorded with Perkin Elmer Model 21 double beam spectrophotometer with NaCl optics in the region 3500 cm^{-1} –700 cm^{-1} and by Perkin Elmer Model 331 grating spectrophotometer in the region 700 cm^{-1} –400 cm^{-1} . The method of recording the Raman spectra was the same as that reported in our earlier work.³ The vibrational frequencies and the assignments to the various modes of vibration are given in Table I.

Beer *et al.*,⁴ from the infrared spectrum of N-methyl propionamide, assigned the doublet at 1276 cm^{-1} and 1243 cm^{-1} as the amide III band. The corresponding frequencies in the Raman spectrum as recorded by the authors are at 1266 cm^{-1} and 1234 cm^{-1} .

The Raman spectrum of propionamide was recorded by Kohlrausch⁵ and the infrared spectrum of the same amide and of the N-N deuterated amide have been recorded by the authors. These spectra are shown in Figs. 1 and 2. Replacement of the amide hydrogen by deuterium was accomplished by adding excess of D_2O to the amide and evaporating the heavy water. About 60% of the compound could be converted to the deuterated amide. The various vibrational frequencies of the functional groups of propionamide and the N-N deuterated amide are given in Table II.

Puranik *et al.*⁶ discussed that the intermolecular associations in amides are of N-H...O=C type. The bands at 3356 cm^{-1} and 3236 cm^{-1} in propionamide are assigned to the

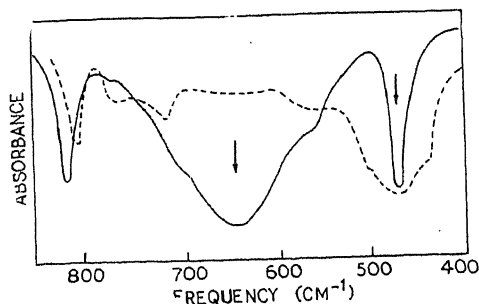
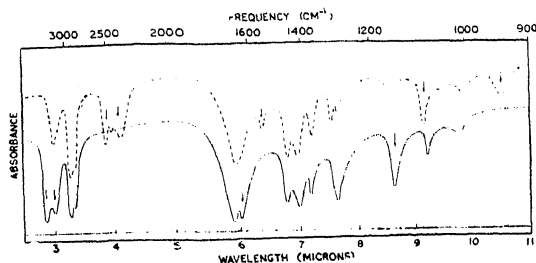
TABLE I

Raman and infrared frequencies of N-methyl and N-N dimethyl propionamides (cm^{-1})

N-Methyl propionamide			N-N dimethyl propionamide		
Infrared	Raman	Assignment	Infrared	Raman	Assignment
3289 (s)	3337 (2)	ν (N-H) bonded	2950 (s)	2943 (3)	ν_{as} (CH_3)
2950 (s)	2940 (4)	ν_{as} (CH_3)	2870 (s)	2875 (5)	ν_s (CH_3)
2870 (m)	2860 (4)	ν_s (CH_3)	1667 (vs)	1625 (7)	ν (C=O)
1646 (vs)	1662 (7)	Amide I	1537 (w)	..	2×766
1552 (s)	..	Amide II	1501 (m)	1452 (7)	ν (C-N)
..	..	..	1441 (s)	..	δ_{as} (CH_3) N, C
1463 (m)	1458 (3)	δ_{as} (CH_3) N, C	1425 (m)	1406 (5)	δ_s (CH_3) N
1412 (m)	1406 (1)	δ_s (CH_3) N	1355 (m)	1350 (7)	δ_s (CH_3) C
1374 (m)	1356 (6)	δ_s (CH_3) C	1298 (s)	1272 (2)	ν_{as} (N- CH_3)
1276 (m)	1266 (2)	Amide III	1178 (vs)	1150 (4)	ν (CH_3) N
1243 (m)	1234 (4)	..	1089 (s)	1063 (2)	γ (CH_3) C
1163 (s)	1146 (6)	ν (CH_3) N	1024 (w)	1003 (1)	γ (CH_2) C
1049 (m)	..	γ (CH_3) C	955 (w)	931 (5)	ν (C- CH_3)
1020 (m)	..	γ (CH_2) C	..	..	..
975 (w)	1001 (5)	ν (N- CH_3)	829 (l)	..	δ (C-H) \perp
868 (w)	864 (9)	ν (C- CH_3)	766 (m)	741 (9)	ν_s (N- CH_3)
797 (s)	797 (0)	δ (C-H) \perp	..	..	..
..	..	..	590 (m)	610 (1)	δ (O=C-N)
685 (br)	..	δ (N-H) \perp	480 (m)	483 (5)	δ_{as} (N- CH_3)
580 (m)	590 (4)	δ (O=C-N)	..	395 (6)	δ (C- CH_3)
..	..	..	..	247 (3)	δ_s (N- CH_3)
436 (m)	423 (6)	δ (C- CH_3)			
..	283 (1)	δ (C-N- CH_3)			

TABLE II

Propionamide			N-N deuterated propionamide		
Mode of vibration	Pure amide	In solution of chloroform	Mode of vibration	Pure amide	In solution of chloroform
ν_{as} (N-H)	3356	3534	ν_{as} (N-D)	2519	2584
ν_s (N-H)	3236	3460	ν_s (N-D)	2370	2415
ν (C=O)	1653	1681	ν (C=O)	1637	1664
δ (N-H)	1629	1603	δ (N-D)	1080	1074
γ (N-H)	1139	1117	γ (N-D)	940	..
τ (N-H)	660	..	τ (N-D)	480	..
ν (C-N)	1297	1244	ν (C-N)	1316	1307



FIGS. 1-2. Infrared spectra of propionamide (solid line) and of the N-N deuterated propionamide (broken line) in Nujol paste.

asymmetric and symmetric stretching vibrations of the bonded NH_2 group and the bands at 3534 cm^{-1} and 3460 cm^{-1} of the same amide in solution of chloroform to the same modes of vibration of the free NH_2 group. The bands at 2519 cm^{-1} and 2370 cm^{-1} in the deuterated amide are likewise due to the asymmetric and symmetric stretching modes of the ND_2 group. The band at 1653 cm^{-1} in propionamide, which is the C=O stretch, shifts to 1681 cm^{-1} in

solution of CHCl_3 , but in the deuterated amide, this band occurs at a lower frequency at 1637 cm^{-1} and shifts to 1664 cm^{-1} in solution. The N-H inplane deformation frequency which occurs at 1629 cm^{-1} in propionamide shifts to 1603 cm^{-1} in solution and in the deuterated amide, this band becomes extremely weak and is replaced by a band at 1080 cm^{-1} which is due to δ (N-D) vibration. The rocking vibration of the NH_2 group gives an absorption at 1139 cm^{-1} and the band at 940 cm^{-1} is due to the same mode of vibration of the ND_2 group. A broad band at 660 cm^{-1} is due to the wagging mode of the NH_2 group and in the deuterated amide, it is replaced by a band at 480 cm^{-1} . The band at 1297 cm^{-1} in propionamide is the C-N stretch and unlike in secondary amides this frequency increases to 1316 cm^{-1} in the deuterated amide. Similar result was obtained by Suzuki⁷ in his studies of formamide. The position of the various bands arising out of the NH_2 and ND_2 vibrations are shown by arrows in Figs. 1 and 2.

Two of us (V. V. C. and C. A. I.) are grateful to the University Grants Commission for awarding Research Fellowships.

1. Tatuso Miyazawa, Takehiko Shimanouchi and San-Ichiro Mizushima, *J. Chem. Phys.*, 1956, **24**, 408.
2. Lumley Jones, *J. Mol. Spect.*, 1963, **11**, 411.
3. Venkata Ramiah, K. and Venkata Chalapathi, V., *Curr. Sci.*, 1965, **34**, 12.
4. Beer, M., Kessler, H. B. and Sutherland, G. B. D. M., *J. Chem. Phys.*, 1958, **29**, 1097.
5. Kohlrausch, K. W. F., *Ramanspektren*, 1943, p. 275.
6. Puranik, P. G. and Venkata Ramiah, K., *Proc. Ind. Acad. Sci.*, 1961, **54**, 69.
7. Isao Suzuki, *Bull. Chem. Soc. Japan*, 1960, **33**, 1359.

A REVISION OF SOME GRAMINICOLOUS *HELMINTHOSPORIA**

C. V. SUBRAMANIAN

Centre for Advanced Studies, University Botany Laboratory, Madras

AND

B. L. JAIN

Botany Department, University of Rajasthan, Jaipur

THE taxonomy of graminicolous species of *Helminthosporium* has been the subject of much study and discussion during the past few years (Luttrell^{1,2}; Nelson³; Shoemaker^{4,5}; Hughes⁶; Subramanian⁷; Rapilly⁸). This is a sequel to the discovery that in the type species of *Helminthosporium* Link ex Fries (*H. velutinum* Link ex Fries) the phragmospores are produced apically and laterally on erect conidiophores as in *Spondylocladium atrovirens* Harz [= *Helminthosporium atrovirens* (Harz) Mason and Hughes], whereas in the graminicolous species assigned to this genus the spores are produced on sympodulæ. Although the spores in *H. velutinum* and in the graminicolous species are now considered to be porospores, the differences in conidiophore behaviour between the former and the latter are, in the light of recent trends in the classification of Hyphomycetes based on conidiophore behaviour and spore types, such that both of them cannot be retained in the same genus. In other words, *Helminthosporium* Link can take in only forms producing many-septate porospores which are acropleurogenous on conidiophores showing no sympodial growth. The graminicolous species, many of which cause plant diseases, have to be accommodated elsewhere. The classification of these graminicolous species is the subject of this paper.

One approach to this question is seen in the proposals made by Shoemaker⁴ who disposed species belonging to the subgenus *Cylindro-Helminthosporium* (Drechsler,⁹ Nisikado¹⁰) in the genus *Drechslera* Ito¹¹ and the remaining species belonging to the subgenus *Eu-Helminthosporium* (Drechsler,⁹ Nisikado¹⁰) in the genus *Bipolaris* which he established to accommodate them. Another approach is that of Luttrell² who, motivated by the commendable desire of retaining the generic name *Helminthosporium* for these graminicolous species in deference to long-established usage, suggests that *Helminthosporium* "should be redefined with *H. maydis*

Nisik. and Miy. as the type and conserved for species in the subgenera *Cylindro-Helminthosporium* and *Eu-Helminthosporium*. . . *Spondylocladium* with *S. atrovirens* (Harz) Harz ex Sacc. as the type should be conserved for species in *Spondylocladium* auct." and the species congeneric with it.

As far as we are aware, neither of these proposals has been readily accepted, although Luttrell's proposal is quite recent and it is too early to expect comments on it. During the course of our studies on variation and variability of these fungi with special reference to forms collected in India, we have naturally considered the question of their taxonomy carefully. Our conclusions are summarized here.

Luttrell's² suggestion involves conservation of two generic names (*Helminthosporium* and *Spondylocladium*), besides the choice of types for both these generic names different from the respective types attached to these names by their authors. Indeed, this also means deliberate rejection of the legitimate types which have been available for study and hence well understood. The type of the genus *Spondylocladium* Mart. is itself stated to be congeneric with the type species of *Stachylidium* Link ex Fries (Hughes⁶). To our mind, Luttrell's suggestion is too complicated and beset with too many difficulties.

Although no such difficulties are posed by the proposals of Shoemaker,⁴ doubt has been expressed about the desirability of distributing the graminicolous species in two separate genera, *Drechslera* and *Bipolaris* (Subramanian,⁷ Luttrell²), as has been done by Shoemaker.⁴ That these graminicolous species fall into two major groups corresponding to *Cylindro-Helminthosporium* and *Eu-Helminthosporium* has been known for over forty years and, although Ito segregated the species in *Cylindro-Helminthosporium* and placed them in a separate genus *Drechslera* as early as 1930, this segregation was not accepted by many workers until Hughes⁶ and Shoemaker⁴ revived this name. For, few workers considered it necessary to

* Memoir No. 21 from the Centre for Advanced Studies, University Botany Laboratory, Madras.

have two separate genera for these two groups of species. While Nisikado¹⁰ proposed two subgenera to take in these, Drechsler⁹ himself merely recognized two groups within this genus. While it is admitted that the general spore morphology (shape, mode of germination, etc.) on which the separation into the two groups is based can be recognized usually without difficulty, the question to be considered is whether the differences are of the magnitude to justify separation into two genera. In our humble opinion, they are not. In fact, examining more closely the species which are distributed in the genera *Drechslera* and *Bipolaris*, one sees further groups of species here which can be bundled together as having certain other significant features in common. Several species (*Helminthosporium halodes* Drechsler, *H. turcicum* Pass., *H. pedicellatum* Henry, *H. monoceras* Drechsler, *H. micropus* Drechsler, *H. holmii* Luttrell) have spores with a conspicuous protruding hilum and in studies on some of these species we have found this character invariable. Coupled with the presence of this protruding hilum is the fact that germ tube emergence during germination is usually not through the hilum but extra-hilar. If one now stresses relationship to the perfect state as an additional argument for generic separation, as has been done by Shoemaker⁴ for *Drechslera* and *Bipolaris* whose perfect states are in *Pyrenophora* and *Cochliobolus* respectively, then the species with protruding hila, as far as known, have perfect states in *Trichometa-sphaeria* and, therefore, following a similar line of thought, may well be re-classified in a separate form-genus. There are also several species usually disposed in *Cylindro-Helminthosporium* (in *Drechslera*, by Shoemaker) which have spores which are not strictly cylindrical but in some cases even distinctly and characteristically obclavate and, therefore, are not easily placed in *Cylindro-Helminthosporium*. A few short- and few-septate-spored species such as *H. triseptatum* Drechsler, *H. dematioideum* Bub. & Wrob. and *H. biforme* Mason & Hughes also exist and according to Ibrahim and Threilfall¹² these deserve segregation into a separate genus *Tetracellaris*. In this way one can see a hierarchy of differences in the graminicolous species as a whole. Nevertheless, what appears to us to be most striking and significant about them are the features that unite all these forms. No doubt, the forms assigned to *Drechslera* appear to be somewhat more specialized in parasitism than those placed in *Bipolaris*, but this again is not a feature of much taxonomic

significance at least in so far as these species are concerned.

Considering all these facts, we recognize the unity of all these species and, since they cannot be retained in *Helminthosporium* as now known from a study of its type species, we suggest that they be accommodated in a single genus, *Drechslera* Ito, which is the earliest validly published name available. Accordingly, *Bipolaris* Shoemaker is reduced to synonymy with *Drechslera*. A possible objection to this proposal is that several new combinations in *Drechslera* would be necessary and, although we are reluctant to publish new combinations in view of those that have been made in the genus *Bipolaris* by Shoemaker,⁴ there is unfortunately no better alternative. The names in *Bipolaris* proposed by Shoemaker are yet to come into general use. Our proposal underlines the essential unity of all these species recognized by mycologists and plant pathologists for a long time, does not involve conservation of any names or procedures in any way violating the provisions of the Code, and merely brings into general use a generic name proposed many years ago by Ito, in place of the generic name *Helminthosporium* which is unavailable. We hope that this proposal will meet with general approval, particularly from plant pathologists whose sentiments with regard to nomenclatural changes we respect and we offer this proposal as relatively the best among the possibilities all of which pose one difficulty or another.

Drechslera ITO EMEND.

Ito, 1930, *Proc. Imp. Acad. Tokyo* 6 : 455.

Hyphomycete typically producing porospores. Conidiophores erect, septate, simple or branched, brown, geniculate. Conidia phragmospores, borne on sympodulæ, acrogenous, brown, variable in shape, with inserted or protruding basal hilum.

Belongs to the *Helminthosporiaceae* Corda emend. Subram.

So far as known, the perfect states are in *Pyrenophora*, *Cochliobolus* and *Trichometa-sphaeria*.

Lectotype species: *Drechslera tritici-vulgaris* (Nisikado) Ito, 1930, *Proc. imp. Acad. Tokyo* 6 : 355. (= *Helminthosporium tritici-vulgaris* Nisikado, 1928, *Ann. phytopath. Soc. Japan* 2 : 96).

On the basis of the proposals made here, the following transfers are made.

Drechslera arizonica (Sprague) comb. nov.

= *Bipolaris arizonica* Sprague, 1960, *Mycologia*,

52 : 358.

- Drechslera australiense* (Bugnicourt) comb. nov.
= *Helminthosporium australiense* Bugnicourt, 1955, *Rev. gen. Bot.* 62 : 238-43.
- Drechslera bicolor* (Mitra) comb. nov.
= *Helminthosporium bicolor* Mitra, 1930, *Trans. Brit. mycol. Soc.* 15 : 286.
- Drechslera biforme* (Mason & Hughes) comb. nov.
= *Helminthosporium biforme* Mason & Hughes in Chesters, 1948, *Trans. Brit. mycol. Soc.* 30 : 114-117.
- Drechslera brizae* (Nisikado) comb. nov.
= *Helminthosporium brizae* Nisikado, 1928, *Spec. Rept. Ohara Inst. agric. Res.* 4 : 133.
- Drechslera buchloes* (Lefebvre & Johnson) comb. nov.
= *Helminthosporium buchloes* Lefebvre & Johnson, 1949, *Mycologia* 41 : 204.
- Drechslera coicis* (Nisikado) comb. nov.
= *Helminthosporium coicis* Nisikado, 1928, *Spec. Rept. Ohara Inst. agric. Res.* 4 : 136.
- Drechslera cookei* (Sacc.) comb. nov.
= *Helminthosporium cookei* Sacc., 1886, *Syll. Fung.* 4 : 420.
- Drechslera cynodontis* (Marig.) comb. nov.
= *Helminthosporium cynodontis* Marig., 1909, *Micromiceti di Schio, Schio*, p. 27.
- Drechslera dematioideum* (Bub. & Wrob.) comb. nov.
= *Helminthosporium dematioideum* Bub. & Wrob. in Bub., 1916, *Hedwigia* 57 : 337.
- Drechslera eragrostidis* (P. Henn.) comb. nov.
= *Helminthosporium eragrostidis* P. Henn., 1908, *Annal. Musée du Congo, Tervuren, Belg., Bot. serie 5*, 2 : 231.
- Drechslera euchlaenae* (Zimm.) comb. nov.
= *Helminthosporium euchlaenae* Zimm., 1904, *Ber. Land.-u. Forstw. Kaiserl. Gouv. Deutsch-Ostafrika* 2 : 18.
- Drechslera halodes* (Drechsler) comb. nov.
= *Helminthosporium halodes* Drechsler, 1923, *J. agric. Res.* 24 : 709.
- Drechslera hawaiiense* (Bugnicourt) comb. nov.
= *Helminthosporium hawaiiense* Bugnicourt, 1955, *Rev. gen. Bot.* 62 : 238-43.
- Drechslera holmii* (Luttrell) comb. nov.
= *Helminthosporium holmii* Luttrell, 1963, *Phytopathology* 53 : 285.
- Drechslera kusanoi* (Nisikado) comb. nov.
= *Helminthosporium kusanoi* Nisikado, 1928, *Spec. Rept. Ohara Inst. agric. Res.* 4 : 150.
- Drechslera leersiae* (Atk.) comb. nov.
= *Helminthosporium leersiae* Atk., 1897, *Cornell Univ. Bull. (Sci.)* 3 (1) : 47.
- Drechslera leucostyla* (Drechsler) comb. nov.
= *Helminthosporium leucostylum* Drechsler, 1923, *J. agric. Res.* 24 : 711.
- Drechslera maydis* (Nisikado) comb. nov.
= *Helminthosporium maydis* Nisikado, 1926, *Sci. Res. Alumni Assoc. Morioka agric. Coll. Japan* 3 : 46 (Japanese diagnosis), 52 (English diagnosis).
- Drechslera mediocre* (Putterill) comb. nov.
= *Helminthosporium mediocre* Putterill, 1954, *Bothalia* 6 : 354.
- Drechslera micropa* (Drechsler) comb. nov.
= *Helminthosporium micropus* Drechsler, 1923, *J. agric. Res.* 24 : 722.
- Drechslera miyakei* (Nisikado) comb. nov.
= *Helminthosporium miyakei* Nisikado, 1928, *Spec. Rept. Ohara Inst. agric. Res.* 4 : 145.
- Drechslera monoceras* (Drechsler) comb. nov.
= *Helminthosporium monoceras* Drechsler, 1923, *J. agric. Res.* 24 : 706.
- Drechslera nodulosa* (Berk. & Curt.) comb. nov.
= *Helminthosporium nodulosum* Berk. & Curt. in Sacc., 1886, *Syll. Fung.* 4 : 421.
- Drechslera ocella* (Faris) comb. nov.
= *Helminthosporium ocellum* Faris, 1923, *Phytopathology* 18 : 136.
- Drechslera olyrae* (Viegas) comb. nov.
= *Helminthosporium olyrae* Viegas, 1946, *Bragantia* 6 : 381.
- Drechslera oryzae* (Breda de Haan) comb. nov.
= *Helminthosporium oryzae* Breda de Haan, 1900, *Bull. Inst. Bot. Buitenz.* 6 : 11.
- Drechslera panici-miliacei* (Nisikado) comb. nov.
= *Helminthosporium panici-miliacei* Nisikado, 1928, *Spec. Rept. Ohara Inst. agric. Res.* 4 : 42.
- Drechslera pedicellata* (Henry) comb. nov.
= *Helminthosporium pedicellatum* Henry, 1924, *Univ. Minn. agric. Exp. Sta. Tech. Bull.* 22 : 42.
- Drechslera ravenelii* (Curt.) comb. nov.
= *Helminthosporium ravenelii* Curt., 1848, *Amer. J. Sci., ser. 2*, 6 (18) : 352.
- Drechslera sacchari* (Butl.) comb. nov.
= *Helminthosporium sacchari* Butl. in Butl. and Haliz, 1913, *Mem. Dept. Agr. India, Pusa, Bot. ser.*, 6 : 207.
- Drechslera setariae* (Saw.) comb. nov.
= *Helminthosporium setariae* Saw., 1912, *Formosa Dept. Agr. Bull.* 64 : 19.
- Drechslera siliculosa* (Crouan) comb. nov.
= *Helminthosporium siliculosum* Crouan in Crouan and H. M. Crouan, 1867, *Florule du Finestere*, p. 11.
- Drechslera sorokiniana* (Sacc.) comb. nov.
= *Helminthosporium sorokinianum* Sacc. in Sorok., 1890, *Proc. biol. Soc. imp. Univ. Kazan* 22 (3) : 15.
- Drechslera stenospila* (Drechsler) comb. nov.
= *Helminthosporium stenospilum* Drechsler, 1928, *Phytopathology* 18 : 136.

- Iera tetramera* (McKinney) comb. nov.
Uminthosporium tetramera McKinney,
 15, U.S. Dept. Agr. Bull. 1347 : 33.
- Iera triseptata* (Drechsler) comb. nov.
Uminthosporium triseptatum Drechsler,
 3, J. agric. Res. 24 : 686.
- Iera turcica* (Pass.) comb. nov.
Uminthosporium turcicum Pass., 1876,
 L. Comiz. Agr. Parmense 10 : 3.
- Iera urochloae* (Putterill) comb. nov.
Uminthosporium urochloae Putterill, 1954,
 Italia 6 : 365.
- Iera victoriae* (Meehan & Murphy)
 nov.
Uminthosporium victoriae Meehan &
 Murphy, 1946, Science 104 : 413.
- Iera yamadai* (Nisikado) comb. nov.
Uminthosporium yamadai Nisikado, 1928,
 2. Rept. Ohara Inst. agric. Res. 4 : 117.
- Drechslera zeicola* (Stout) comb. nov.
 = *Helminthosporium zeicola* Stout, 1930,
 Mycologia 22 : 273.
- Drechslera zizaniae* (Nisikado) comb. nov.
 = *Helminthosporium zizaniae* Nisikado, 1928,
 Spec. Rept. Ohara Inst. agric. Res. 4 : 173.
1. Lattrell, E. S., *Mycologia*, 1963, **55**, 643.
 2. —, *Ibid.*, 1964, **56**, 119.
 3. Nelson, R. R., *Ibid.*, 1960, **52**, 753.
 4. Shoemaker, R. A., *Canad. J. Bot.*, 1959, **37**, 879.
 5. —, *Ibid.*, 1962, **40**, 809.
 6. Hughes, S. J., *Ibid.*, 1958, **36**, 727.
 7. Subramanian, C. V., *J. Indian bot. Soc.*, 1963,
42 A, 248.
 8. Rapilly, F., *Ann. Epiphyties*, 1964, **15** (3), 257.
 9. Drechsler, C., *J. agric. Res.*, 1923, **24**, 641.
 10. Nisikado, Y., *Spec. Rept. Ohara Inst. agric. Res.*,
 1928, **4**, 1.
 11. Ito, S., *Proc. imp. Acad. Tokyo*, 1930, **6**, 352.
 12. Ibrahim, F. M. and Threlfall, R. J., *Proc. Soc. gen.*
Microbiol. (Final Notice and Abstracts for Meeting,
 London), 1966, p. 6.

DEVELOPMENT OF DWARF STRAINS OF PEARL MILLET AND AN ASSESSMENT OF THEIR YIELD POTENTIAL

J. S. BAKSHI

Assistant Professor, Botany Division, I.A.R.I., New Delhi

AND

K. O. RACHIE AND AMARJIT SINGH

Scientist and Research Associate respectively, The Rockefeller Foundation, New Delhi

Introduction of dwarfing genes in wheat, and sorghum has revolutionized the yield potentials attainable in these crops. These dwarfing genes reduce plant height without affecting reproductive or any other important plant processes and thus permit efficient use of fertilizer and irrigation, conducive to maximization of grain

production. These dwarfing genes are now available. The most promising among these are being tested for their potentialities as breeding stocks and as commercial varieties. One of these stabilized inbreds, D. 174, was found to be particularly promising in Summer 1965 at Delhi and is now in the advanced stages of testing.

Pennisetum typhoides S. & H.) program at the I.A.R.I., major portion was devoted to the development of dwarf strains. For this purpose, a large number of crosses were crossed with four different parents kindly supplied by Dr. G. W. Geiger, Georgia, U.S.A. Progenies from these crosses were grown at Coimbatore and during different seasons to select the lines with desirable morphological characters as well as wide range of adaptability. Several

hundred stabilized dwarf inbreds ranging in height from 60 to 140 cm., having erect growth habit, upright leaves and large compact heads are now available. The most promising among these are being tested for their potentialities as breeding stocks and as commercial varieties. One of these stabilized inbreds, D. 174, was found to be particularly promising in Summer 1965 at Delhi and is now in the advanced stages of testing.

This inbred—D. 174—was developed from the cross D 2 × IP 81 and was sufficiently uniform for bulking in the F₆ generation. In Kharif season at Delhi, it grows about 1 metre tall, with 5–7 synchronous tillers per plant. Its growth habit is erect and leaves are upright. Its maturity is comparable to other varieties like Pusa Moti and HB-1. During Kharif 1965, it was grown in a demonstration plot at the I.A.R.I. in rows 75 cm. apart with 15 cm.

spacings between plants (Fig. 1). It gave grain yield of 2,171 kg./ha. although in the early vegetative stage it received a slight set-back due to heavy weed growth and late transplanting. With a spacing of 30-45 cm. between rows and 10-15 cm. between plants it may be possible

varieties. These inbreds will become the parents for further breeding as well as parents for hybrids, synthetics and other improved forms. The possibility of their direct commercial use as improved strains to reduce the seed production problems is currently being assessed.



FIG. 1. D. 174 at Delhi Kharif 1965.

to increase substantially the grain yield of this dwarf. Management experiments to obtain this information are under way.
Dwarfs as typified by D.174 may open up new vistas in the yield potential of bajra

The authors wish to express their gratitude to Dr. M. S. Swaminathan, Head of the Division of Botany, I.A.R.I., New Delhi, for his encouragement and deep interest in this work.

SPA
c
bution
that i
in the
some
the c
phase
could
havin
reveal

The
or in
hours
stored
as h
materi
solutic

In
sodium
alone
at gor
gonial
mosom
pair o
gonial
Photo
were f
and tw
the ass
bivalen
(Photo
bivalen
among
supernu
Photo
anapha:

On ge
ana-phe
have li
1900, S
limiting
at goniz
within 1
some is

SOME INTERESTING CYTOLOGICAL FEATURES OF MALE SPATHOSTERNUM PRASINIFERUM WALK.

N. BALAKRISHNAN ELAYIDOM AND M. K. SUBRAMANIAM

Cytogenetics Laboratory, Department of Biochemistry, Indian Institute of Science, Bangalore-12

SPATHOSTERNUM PRASINIFERUM is a common grasshopper having a wide distribution in the Indian continent. We know only that it has 23 ($2n \sigma = 22 + X$) chromosomes in the gonial metaphases,¹ that the X-chromosome is the third or one of the longest in the complement at gonial and second metaphases,^{2,3} and that chromosome aberrations could be induced by injections of 0.67% saline having the pH of 3-4 or 9.⁴ An initial survey revealed some interesting features.

The testes were fixed in acetic alcohol (1:3) or in formal-acetic alcohol (1:1:3) for two hours at room temperature and were either stored in 70% alcohol or processed immediately as haematoxylin squashes.⁵ Some of the material was exposed to 0.9% sodium citrate solution for 30 minutes before fixation.

In the material pretreated with hypotonic sodium citrate solution, the X-chromosome alone had a matrix and a limiting membrane at gonial prophase (Photo 1). Photo 2 is a gonial metaphase. A measurement of the chromosomes revealed an inequality in the longest pair of autosomes (arrow, Photo 3). A rare gonial tetraploid metaphase is illustrated in Photo 4. During meiotic prophase, the nucleoli were found associated with the X-chromosome and two of the bivalents. It would appear that the association of the X-chromosome with the bivalents may be mediated by the nucleoli (Photo 5). At metaphase I, there were 11 bivalents and an allosome (Photo 6). Two among the 500 specimens screened had a supernumerary chromosome as illustrated in Photo 7 of metaphase I and Photo 8 of anaphase I.

On general considerations, only the meta- and ana-phase chromosomes may be expected to have limiting membranes.⁶⁻⁹ As far back as 1900, Sutton¹⁰ had recorded in some insects a limiting membrane for the X-chromosome alone at gonial prophase, when it was still enclosed within the nuclear membrane. The X-chromosome is intriguing in its staining behaviour.

While in some forms its synthesis of DNA is out of phase with that of the autosomes,¹¹ in others, it does not synthesize either DNA or RNA during the meiotic stages.¹² The fact that it is enclosed by a limiting membrane at gonial prophase is, therefore, interesting.

An inequality of the homologues has been reported only in the case of the small autosomes.¹³⁻¹⁵ An inequality in the longest pair of chromosomes is perhaps being recorded here for the first time. Reports on the formation of nucleoli by the X-chromosome of grasshoppers are rather few.¹⁶⁻¹⁷ Photo 5 is suggestive that the nucleoli may mediate the association between the X-chromosome and the bivalents during meiotic prophase.¹⁸

1. Rao, T. R., *J. Morph.*, 1937, **61**, 223.
2. Asana, J. J., Makino, S. and Niiyama, H., *Jap. J. Genet.*, 1930, **15**, 251.
3. Ray-Chaudhuri, S. P. and Dutt, M. K., *Proc. Roy. Soc. Edinb.*, 1947, **62**, 292.
4. Manna, G. K. and Roy, D., *Naturwiss.*, 1964, **51**, 493.
5. Elayidom, N. B., Royan-Subramaniam, S. and Subramaniam, M. K., *Curr. Sci.*, 1966, **35**, 265.
6. Subramaniam, M. K. and Royan, S., *Ibid.*, 1962, **31**, 227.
7. — and Subramanyam, S., *Ibid.*, 1964, **33**, 473.
8. Mangalangi, N. K., Subramanyam, S., Royan-Subramaniam, S. and Subramaniam, M. K., *Ibid.*, 1965, **34**, 278.
9. Subramanyam, S. and Subramaniam, M. K., *Naturwiss.*, 1965, **52**, 626.
- 10.* Sutton, W. S., *Kan. Univ. Quart.*, 1900, **9** (2).
11. Lima-de-Faria, A., *Jour. Biophys. and Biochem. Cytol.*, 1959, **6**, 457.
12. Henderson, S. A., *Chromosoma*, 1964, **15**, 345.
13. Powers, P. B. A., *J. Morph.*, 1942, **71**, 523.
14. White, M. J. D., *Animal Cytology and Evolution*, II Edn.: Cambridge Univ. Press, 1954.
15. Nur, U., *Chromosoma*, 1963, **14**, 407.
16. Gates, R. R., *Bot. Rev.*, 1942, **8**, 337.
17. John, B. and Hewitt, G. M., *Chromosoma*, 1965, **16**, 548.
18. Darlington, C. D., *J. Genet.*, 1936, **33**, 465.

* Not consulted in original.



PHOTOS 1-8. Photo 1. Spermatogonial prophase. Note the matrix and pellicle of the X-Chromosome. Photo 2. Spermatogonial metaphase with 23 chromosomes. Photo 3. Karyotype of gonial metaphase. Arrow indicates the unequal pair of long chromosomes. Photo 4. Tetraploid gonial metaphase ($4n\sigma = 46$). Photo 5. Nucleoli (N) associated with the X-chromosome and two of the bivalents at pachytene. Photo 6. Metaphase I. Photo 7. Metaphase I with supernumerary (arrow). Photo 8. Anaphase I with supernumerary (arrow). Magnification of Photos 2-8 as given in Photo 8.

LETTERS TO THE EDITOR

RADIUS OF SCHWARZSCHILD SINGULARITY IN COSMOLOGICAL BACKGROUND

IN order that the Schwarzschild solution be real, the condition $\gamma_1 > 2m$ is imposed on the radius of a material sphere of given mass m . For $\gamma_1 = 2m$, g_{44} of the Schwarzschild metric vanishes giving rise to the event horizon. The energy consideration of spherical distributions in general relativity leads to another interpretation of this surface singularity. In isotropic co-ordinates, Möller's energy-momentum complex¹ in the framework of a tetrad formalism of the general relativity theory gives a non-zero energy $m^2/2\rho_1$ for the Schwarzschild's exterior field of a material distribution of radius ρ_1 embedded in an otherwise flat background² and $(m - m^2/2\rho_1)$ as the total energy for the interior field. Hence for the radius $\rho_1 = m/2$ in these co-ordinates (which is equivalent to the radius $\gamma_1 = 2m$ in Schwarzschild co-ordinates), the energy within the sphere becomes zero.

We now use this energy interpretation of the Schwarzschild's singular surface in the case when the spherical material system is embedded in a cosmological background. The cosmological applications of Möller's tetrad formalism have been considered by us earlier.³ For the Einstein static universe, of constant radius $2R_0$, given by the metric

$$-ds^2 = R^{-1} [d\rho^2 + \rho^2 d\theta^2 + \rho^2 \sin^2 \theta d\phi^2] - dt^2$$

where $R^2 = 1 + \rho^2/4R_0^2$, the total energy comes out to be R_0 . Using the McVittie metric⁴

$$-ds^2 = R^{-1} \left\{ \frac{1 + mR}{2\rho} \right\}^4 [d\rho^2 + \rho^2 d\theta^2 + \rho^2 \sin^2 \theta d\phi^2] - \left(\frac{1 - mR/2\rho}{1 + mR/2\rho} \right)^2 dt^2$$

for the exterior field of a star embedded in the Einstein universe, we get the following expression for the total energy H_0 of the exterior field,

$$H_0 = R_0 - \frac{\rho_1^3}{2R_0^2 R_1^4} + \frac{m^2}{2\rho_1} \left(1 - \frac{\rho_1}{2R_0} \right) + \frac{m}{(2)^{3/2}} - \frac{m}{R_1^3}$$

where $\rho = \rho_1$ is the outer boundary of the star and $R_1^2 = 1 + \rho_1^2/4R_0^2$. Assuming that the total energy of the star and the background universe is the same as that of the Einstein

universe, i.e., R_0 , we get the energy H_i , within the star of radius ρ_1 , given by

$$H_i = 0.6464 m - m^2/2\rho_1$$

where we have neglected the terms of the order ρ_1/R_0 . Thus putting $H_i = 0$ in this case, the Schwarzschild radius will be $\rho_1 = 0.7734 m$ which when couched in Schwarzschild co-ordinates becomes $\gamma_1 = 2.096 m$. We therefore conclude that the presence of the cosmological background increases the radius of the event horizon by about 4.8%.

I would wish to put on record my thanks to Prof. P. C. Vaidya for helpful discussions.

Physical Research Laboratory, K. B. SHAH.
Ahmedabad-9 (India),
January 3, 1966.

1. Möller, C., *Mat. Fys. Skr. Dan. Vid. Selsk.*, 1961, 1, No. 10.
2. Shah, K. B., *Curr. Sci.*, 1963, 32, 496.
3. —, *Thesis for M.S. Degree* at the University of Maryland, U.S.A., 1963.
4. McVittie, G. C., *Monthly Not. Roy. Astron. Soc.*, 1933, 93, 325.

Cl³⁵ PURE QUADRUPOLE RESONANCES IN THREE ORGANIC COMPOUNDS

Cl³⁵ PURE Quadrupole Resonances have been observed in (1) 2, 5-dichloro phenol, (2) 2, 6-dichloro aniline and (3) 4-fluoro, 3-chloro aniline. These have not so far been reported in any previous investigations. The conventional frequency modulated super-regenerative oscillator has been used. The frequencies are measured by a BC-221 Q frequency meter and are shown in Table I. The frequency accuracy is estimated as less than ± 5 kc./s.

TABLE I

Compound	Resonance frequency Mc./s.	Temperature °C.
(1) 2, 5-Dichloro phenol ..	34.647 } 35.277 }	28
(2) 2, 6-Dichloro aniline ..	34.375 } 34.984 }	-183
(3) 4-Fluoro, 3-chloro aniline	35.420 } 36.127 }	28 -183

In each of the compounds (1) and (2) two lines have been observed for Cl³⁵. In (1) both the lines could be observed only at the room temperature while for (2) the lines are observed

only at liquid oxygen temperature. In 4-fluoro 3-chloro aniline a single line is observed both at room temperature and at liquid oxygen temperature.

The two lines observed for compounds (1) and (2) are obviously ascribed to the different environment of Cl in the molecules.

The author is deeply indebted to Prof. K. R. Rao for his guidance. The award of a Fellowship by the Council of Scientific and Industrial Research is gratefully acknowledged.

Physics Department, B. KANTIMATI.
Andhra University,
Waltair, April 22, 1966.

DIELECTRIC BEHAVIOUR AT 3 cm. OF SOME MONOSUBSTITUTED ANILINES

THE dielectric constant and the dielectric loss of two to three different sets of dilute solutions in benzene of *o*-, *m*-, *p*-anisidines, *o*-, *p*-phenetidines and *m*-, *p*-fluoroanilines have been measured at 3.26 cm. at room temperature, $25 \pm 1^\circ \text{C}$. in the manner of Hiremath and Rao^{1,2} and Deshpande and Rao,³ using more or less the same experimental set-up employed by them. The dielectric constant at 1 Mc/s and the refractive index for the sodium D line of dilute solutions of these compounds in the same solvent have also been measured at the same temperature, employing the method described previously.¹⁻³ Applying the single frequency method of Gopalakrishna⁴ to the microwave measurements and Guggenheim's method⁵ to the radiofrequency measurements, relaxation times, τ and dipole moments μ have been deduced for these molecules and are presented in Table I.

TABLE I

Molecule	Microwave		Radio-
	τ in picoseconds	μ in debyes	frequency μ in debyes
<i>o</i> -Anisidine	.. 3.0	1.43	1.45
<i>m</i> -Anisidine	.. 3.5	1.76	1.85
<i>p</i> -Anisidine	.. 3.0	1.84	1.95
<i>o</i> -Phenetidine	.. 4.0	1.40	1.52
<i>p</i> -Phenetidine	.. 3.5	1.75	1.54
<i>m</i> -Fluoroaniline	.. 6.3	2.22	2.13
<i>p</i> -Fluoroaniline	.. 8.0	2.34	2.47

The dipole moments are estimated to be accurate to 3 to 5% and the relaxation times, to 15 to 20%.

From the observed increase of the dipole moment from *ortho*- to *para*- through *meta*-isomer in anisidines and phenetidines, it may be inferred, in analogy with a similar increase

observed in halogenated toluenes, that the positive end of both methoxy and ethoxy dipoles is toward the ring.

Dept. of Physics, D. K. DESHPANDE.
Karnatak Univ., K. SURYANARAYANA RAO.
Dharwar-3, March 14, 1966.

1. Hiremath, G. C. and Suryanarayana Rao, K., *Ind. J. Phys.*, 1964, **53**, 194.
2. — and —, *Proc. Nat. Inst. Sci.* (In press).
3. Deshpande, D. K. and Suryanarayana Rao, K., (Communicated).
4. Gopalakrishna, K. V., *Trans. Far. Soc.*, 1957, **53**, 767.
5. Guggenheim, E. A., *Ibid.*, 1949, **45**, 714; 1951, **47**, 573.

NEAR ULTRAVIOLET EMISSION SPECTRUM OF 2-FLUOROANILINE

THE present communication deals with the emission spectrum of 2-fluoroaniline vapour, which has been recorded for the first time. As regards earlier spectroscopic studies on this molecule, Shashidhar and Rao,¹ and Murty and Shanthamma² have recorded its ultraviolet absorption in vapour phase. Kohlrausch, Herz and Vogel³ have reported the interpolated Raman frequencies. Krueger⁴ has studied its infrared absorption in the N-H stretching frequency region.

The emission spectrum has been obtained by an uncondensed transformer discharge through the flowing vapour of the substance in a conventional π type discharge tube, 50 cm. long and of 16 mm. diameter. The voltage applied between the two electrodes of the discharge tube was 3,500 volts A.C. The spectrum was recorded on Zeiss Q-24 Medium Quartz Spectrograph. The exposure time varied from 3 to 5 hours on Ilford N-40 plates with a slit width of 30μ . Copper arc spectrum was superposed centrally for comparison and bands were measured on Hilger L 76 comparator.

The spectrum lies in the region 2890–3160 Å and consists of more than 40 bands. The entire spectrum is superposed by a strong continuum, which has masked the bands.

The molecule, 2-fluoroaniline, in which ' NH_2 ' group and 'F' atom lie in the 1 and 2 position of the benzene ring, can be approximately taken to belong to C_s symmetry, with the molecular plane as the only element of symmetry. The electronic transition responsible for the present system is $A'-A'$ and is an allowed one. The strong band of the system at 34583 cm^{-1} has been taken as 0-0 band. The spectrum has been analysed in terms of the frequencies shown in Table I as ground state vibrational frequencies.

TABLE I
Ground state frequencies of 2-fluoroaniline

Raman spectrum ³ ..	195	..	285	330	..	535	..	765	..	860	1030	1155	1270	1580
Emission spectrum..	195	252	288	322	428	549	668	762	830	878	1028	1207	1288	1584

The correlation between the ground state frequencies in emission and the Raman spectrum is also given.

The authors are grateful to Dr. I. S. Singh for his useful suggestions. One of us (S. N. Singh) is also thankful to the C.S.I.R., New Delhi, for financial assistance.

Department of Spectroscopy, S. N. SINGH.
Banaras Hindu University, N. L. SINGH.
Varanasi-5, March 18, 1966.

1. Shashidhar, M. A. and Rao, K. S., *Curr. Sci*, 1965, **34**, 479.
2. Murty, S. N. M. and Shanthamma, C., *Ind. J. Pure and Appl. Phys.*, 1965, **3**, 495.
3. Kohlrausch, K. W. F., Herz E. and Vogel, R., *Mh. Chem.*, 1947, **76**, 249.
4. Krueger, P. J., *Canad. J. Chem.*, 1962, **40**, 2300.

PYRIDINE N-OXIDE COMPLEXES OF NICKEL

In recent years a number of pyridine N-oxide (PyO) complexes of transition metals have been reported and characterised.^{1,2} Attempts have been made to establish the structure of these complexes by electronic spectra,³ infra-red spectra⁴ and magnetic susceptibilities often measured at room temperature.⁵⁻⁷ We have undertaken a systematic work on the magnetic susceptibilities of nickel complexes of this ligand at various temperatures and we report here the data on the bromide and the iodide of the hexakis pyridine N-oxide nickel (II) and a tetrakis complex Ni(PyO)₄I₂; the last named compound does not seem to have been reported so far. The magnetic susceptibilities of complexes were measured using Gouy method at several temperatures between 85° and 300° K. The results of analysis and the magnetic data are summarized in Table I.

When the reciprocal of molar susceptibilities (χ_M') of the hexakis pyridine N-oxide complexes, corrected for diamagnetism of the constituent atoms, were plotted against temperature (T), a linear relation was observed over the whole temperature range. The values of θ observed were small indicating that the compounds obey essentially a Curie Law. The data are in agreement with the view that the complexes are octahedral. The octahedral configuration is also confirmed by the absorption spectra in the

visible region.² Following Ballhausen,⁸ χ_M' can be expressed as a sum of temperature dependent and temperature independent (χ_p) terms, namely,

$$\chi_M' = \frac{8N\beta^2}{3kT} \left(1 - \frac{4\lambda}{10Dq}\right)^2 + \frac{8N\beta^2}{10Dq} \quad (I)$$

where λ is the spin orbit coupling constant and 10 Dq is the ligand field strength. The χ_p terms for these compounds have been calculated by using 10 Dq values obtained from the absorption spectra.² The χ_p values for the hexakis compounds (Table I) are about 5% of the χ_M' values observed at room temperature. Subtracting these χ_p values from χ_M' , the magnetic moment of nickel and the spin orbit coupling constant have been calculated for these complexes. It is observed that the values of the magnetic moment are in the range generally observed for octahedral complexes and show a substantial orbital contribution. The value of the spin orbit coupling in these complexes is nearly the same as that for the free ion⁹ ($\lambda_0 = -335 \text{ cm}^{-1}$). The orbital reduction factor k is nearly unity indicating that the bond formed between nickel and the ligand is predominantly ionic.

When the yellow [Ni(PyO)₆]I₂ complex is heated to 100° C. a red compound is formed. Chemical analysis of the complex shows that its composition is Ni(PyO)₄I₂. It is a very unstable complex and changes its colour to yellow when exposed to atmospheric air; it is decomposed when dissolved in water, is insoluble in almost all organic solvents but slightly soluble and stable in tetrahydrofuran. The plot of $1/\chi_M'$ against T for this compound is a straight line with θ value smaller than the hexakis compound. The magnetic moment of this compound is nearly the same as that of the corresponding hexakis complex. From the magnetic data it is concluded that the red complex is also octahedral. Its reflectance spectrum shows a band at 13900 cm⁻¹ which is ascribed to the d-d transition ${}^3A_1 \rightarrow {}^3T_2$ (18 Dq). From this the 10 Dq value obtained is 7720 cm⁻¹ which is lower than that for the hexakis compound (8810 cm⁻¹). The spin orbit coupling constant obtained using expression I is less than that observed for the hexakis complex. The orbital reduction factor is consequently less (0.8) for the tetrakis complex. The conductivity measurements made in tetrahydrofuran solution

TABLE I

Complex	Element	Analysis		IO Dq (cm. ⁻¹)	$\chi_p \times 10^6$	μ obs. (B.M.)	μ (lit) B.M.	θ (° K.)	λ (cm. ⁻¹)	Orbital reduction factor (δ)	N-O stretching frequency (cm. ⁻¹)
		Found %	Calculated %								
[Ni(C ₂ H ₅ NO) ₆]Br ₂	C	44.9	45.6	8810	231	3.26 ± 0.02	3.28 (1)	-8	-335	1.0	1218
	H	4.0	3.6								
	N	9.8	10.6								
	Ni	7.4	7.4								
[Ni(C ₂ H ₅ NO) ₆]I ₂	C	40.1	40.8	8810	231	3.26 ± 0.02	..	-4	-335	1.0	1220
	H	3.3	2.4								
	N	9.4	9.5								
	Ni	6.75	6.6								
[Ni(C ₂ H ₅ NO) ₄]I ₂	C	34.2	34.6	7720	265	3.21 ± 0.02	..	-1	-263	0.8	1220
	H	3.1	2.8								
	N	7.6	8.1								
	Ni	8.4	8.4								

show that the substance has very low molecular conductance indicating that the complex is non-ionic; presumably the iodine is in the inner co-ordination sphere and occupies two positions of the octahedron.

The infra-red spectra of all the compounds show great similarities. The N-O stretching frequency in both complexes is smaller than that for the pure ligand. The formation of O-M bond increases the electron demand of the donor oxygen atom and thus brings about decrease in the double bond character of N-O group in the two complexes. However, the double bond character in both tetrakis and hexakis complexes is practically the same.

Tata Institute of
Fundamental Research,
Bombay-5. April 9, 1966.

C. R. KANEKAR.
S. V. NIPANKAR.

LEAD CONTENT OF THE DECCAN TRAPS

KALAPESI AND SUKHESWALA¹ in their paper on the Age of the Deccan Traps of the Bombay and Salsette islands have given the lead content of several samples of the Deccan Traps, determined by the method of chemical analysis. A sample from a quarry near Danda (Bandra) showed that the amount of lead was 0.00038%. This rock powder was supplied by Dr. Sukheswala, Head of the Geology Department, St. Xavier's College, Bombay, and was examined by spectrochemical method for its lead content.

Besides the most sensitive lines—4057, 3683, 2833, of lead—the lines 3740, 3639, 2614, 2802 also appeared on the plate. As shown by Ahrens and Taylor,² 4 ppm is approximately the limit of concentration of lead detectable by spectroscopic method. The fact that so many lines of lead could easily be photographed, showed that lead was in considerably larger amount than that found by chemical analysis. Wedepohl's results, as quoted by Ahrens, show that in igneous rocks the abundance of lead is of the order of 15 ppm.

Two parts of rock powder were mixed with one part of sodium carbonate added as a buffer to keep the temperature of the arc as uniform as possible. The electrodes were shaped from Ringsdorff carbons. Anode excitation was used and the electrode bore was 10 mm. deep, 3.2 mm. internal diameter and wall thickness of 0.5 mm. The counter electrode was pointed.

Many investigators have preferred to work with low intensity arcs for lead analysis. With

1. Quagliano, J. V., Fujita, J., Franz, G., Phillips, D. J., Walmsley, J. A. and Tyree, S. V., *J. Amer. Chem. Soc.*, 1961, **83**, 3770.
2. Carlin, R. L., *Ibid.*, 1961, **83**, 3773.
3. Meek, D. W., Drago, R. S. and Piper, T. S., *Inorg. Chem.*, 1962, **1**, 235.
4. Kida, S., Quagliano, J. V., Walmsley, J. A. and Tyree, S. V., *Spectro. Chem. Acta*, 1963, **19**, 189.
5. Harris, C. M., Kokot, E., Lenger, S. L. and Lockyer, T. N., *Chem. Ind. (London)*, 1962, p 651.
6. Hatfield, W. E., Fay, R. C., Pfuger, C. E. and Piper, T. S., *J. Amer. Chem. Soc.*, 1963, **85**, 265.
7. —, Muto, Y., Jonassen, H. B. and Paschal, J. S., *Inorg. Chem.*, 1965, **4**, 97.
8. Ballhausen, C. J., *Introduction to Ligand Field Theory*, McGraw-Hill Book Co., New York, 1962, p. 142.
9. Schlapp, R. and Penney, W. G., *Phys. Rev.*, 1932, **42**, 666.

this rock powder no line of lead was obtained until the current exceeded seven amperes. This could be due to the fact that in the complex matrix some unknown ingredient depressed the emission lines of lead. The usual practice of compounding comparison standards was therefore not advisable, and the method of addition was followed.

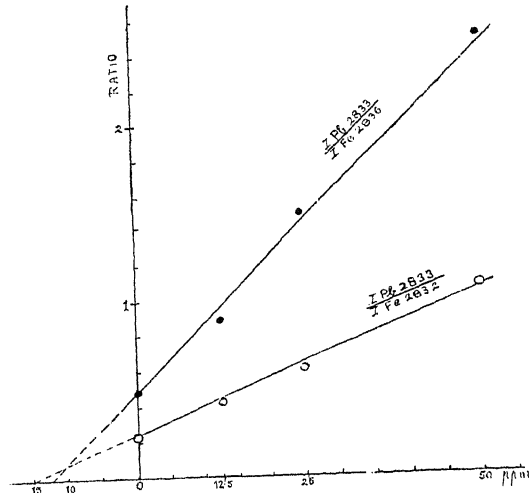


FIG. 1

Three standards were prepared by adding Pb_2O_3 to the rock powder. The concentration of lead in the standards was $(x + 0.00125)$, $(x + 0.0025)$, and $(x + 0.005)$ %, where x % is the concentration of lead in the rock sample.

The arc separation was 4 mm, and the centre of the arc was focused with the Zeiss-system on the slit of Q 24-Zeiss Spectrograph, the slit width being 10μ . The arc was run at 45 volts and 9 amperes. Ten seconds after starting the arc, an exposure of ten seconds was given in each case. This short exposure, almost immediately after starting the arc, was given to minimise the effect of self-reversal of Pb-lines.

The photographic response-relative intensity curve was constructed with Fe lines, with relative intensities given by Ahrens and Taylor.² Pb 2833 was used for analysis, with Fe lines 2832 and 2836 as internal standards.

The lead concentration in the rock sample as obtained from the graph is 14 ± 1 ppm.

Dept. of Physics, S. J. KHAMBATA.
St. Xavier's College, M. D. MIRANDA.
Bombay, March 24, 1966.

CHEMICAL EXAMINATION OF THE LEAVES OF CASSIA JAVANICA LINN.

VARIOUS *Cassia* species have been the subjects of chemical investigation because of their tanning and medicinal properties.¹ *Cassia javanica* Linn. is an ornamental tree with light pink flowers and is reported¹ to be a native of Java and Sumatra. When the present work on the leaves was in progress Khorana *et al.*² reported the presence of 0.25 to 0.4% of free anthraquinones and 1.3% of combined anthraquinones in these leaves, but the isolation of only rhein and its glucoside. In the present study besides these, two more anthraquinones, chrysophanol and aloë-emodin are found to be present in small amounts. In addition four flavonoids have also been isolated.

The air-dried powdered leaves collected locally in July-August were exhaustively extracted with hot alcohol. The alcohol extract was concentrated under reduced pressure and water added. Some solid separated which was found to contain polymeric leucoanthocyanidins. The aqueous alcoholic filtrate was extracted with petroleum ether to remove waxes and chlorophyll and then successively with ether and ethyl acetate respectively. 400 mg. of the ether extract (yield 1.2%) was chromatographed over silica gel column and the following five fractions were obtained on elution; fraction (a) with ethyl acetate-benzene (1:3), 40 mg.; (b) with ethyl acetate-benzene (1:1), 30 mg.; (c) with ethyl acetate, 120 mg.; (d) with acetone and acetone-methanol (1:1), 100 mg.; and (e) with methanol, 30 mg.

Fraction (a) crystallised from ethyl acetate-petroleum ether as pale yellow needles, m.p. 278–280° and was identified to be kempferol by m.p., U.V. and visible spectra and confirmed by m.m.p., co-chromatography with the authentic sample and preparation of tetraacetate, m.p. 182–184°. Fraction (c) crystallised from methanol as pale yellow prisms, m.p. 225–227° and was found to be glycosidic in nature. After acid hydrolysis with 7% sulphuric acid the aglycone and the sugar moiety were identified to be kempferol and rhamnose respectively by comparison with authentic samples. To locate the site of glycosidic linkage in the glycoside it was fully methylated with dimethyl sulphate in anhydrous acetone solution containing suspended potassium carbonate. The resulting methyl ether on acid hydrolysis gave kempferol-5:7:4'-trimethyl ether, m.p. 149–150°; λ_{\max} . (in methanol) 260, 308 and 355 μ ; with aluminium chloride, λ_{\max} , 267,

1. Kalapesi, A. S. and Sukheswala, R. N., *Jour. Bom. University*, 1944, 12 (5).

2. Ahrens and Taylor, *Spectrochemical Analysis*.

330 and 410–15 m μ , a bathochromic shift of 15–60 m μ was observed in the band I which is characteristic of a free 3-hydroxyl group. Acetate of the glycoside had m.p. 157–158°. The data agreed completely with that recorded for kempferol-3-rhamnoside,³ and so the glycoside was considered to have the same constitution.

Fraction (b) contained another compound admixed with the above two. This was separated by preparative thin-layer chromatography on silica gel using ethyl formate-toluene-formic acid mixture (4:5:1). The compound gave colour reactions and spectral characteristics of flavonoids but it could not be identified due to lack of material.

Fraction (d) was a mixture of anthraquinones and very small amount of flavonoids. The separation of these was achieved by preparative thin-layer chromatography over silica gel using ethyl formate-toluene-formic acid mixture (4:6:1). Three bands of anthraquinones appeared distinctly while a small amount remained at the origin. The above three bands were scrapped off from several plates and eluted with acetone. Each fraction was purified by repeating the process. These were identified as chrysophanol, rhein and aloë-emodin on the basis of absorption spectra in the U.V. and visible regions and co-chromatography on paper and thin-layer (silica gel) using a number of solvent systems. Fraction (e) was glycosidic in nature. On acid hydrolysis it gave rhein as the aglycone and glucose as the sugar moiety as identified by co-chromatography with authentic samples. The above anthraquinone derivatives were found to be present in very small amounts as compared to the findings of Khorana *et al.*²

The ethyl acetate extract indicated the presence of leucoanthocyanidin in good yield. To identify it the leaves were separately extracted in the cold with acetone and the extract was worked up in the manner indicated above. Addition of petroleum ether to the dried ethyl acetate extract precipitated the leucoanthocyanidin admixed with small amount of kempferol-3-rhamnoside. The leucoanthocyanidin was converted into its flavylum salt which after purification was identified to be pelargonidin chloride by colour reactions, visible spectra and co-chromatography with an authentic sample of pelargonidin chloride.

This association of anthraquinone derivatives with flavonoids seems to be common in *Cassia* species. Kämpferol-3-rhamnoside and leucopelargonidin are the major constituents of the leaves of *C. javanica*.

Department of Chemistry,
University of Delhi,
Delhi-7, May 2, 1966.

S. P. BHUTANI,
S. S. CHIBBER,
T. R. SESHADRI.

1. Kirtikar, K. R. and Basu, B. D., *Indian Medicinal Plants*, L. M. Basu, Allahabad, 1933, 2, 877.
2. Kaji, N. N. and Khorana, M. L., *Indian J. Pharm.*, 1965, 27, 338.
3. King, F. E. and Acheson, R. M., *J.C.S.*, 1950, 1, 168.

CHEMICAL EXAMINATION OF THE LEAVES OF *GLIRICIDIA MACULATA* (H.B. AND K.) STEUD.

Gliricidia maculata (H.B. & K.) Steud. [syn. *G. sepium* (Jacq.) Walp.] is a tall shrub cultivated in South India as a green manure and as a hedge plant.¹ The seeds were examined for their proximate constituents and the seed oil for its chemical constants by Earle *et al.*² The presence of coumarin, o-coumaric acid and melilotic acid was detected paper chromatographically in the leaves by Griffiths *et al.*³ The flowers were found to contain quercetin 3-glucoside by Nair and Sankar-subramanian.⁴ In the present investigation the leaves were subjected to a complete study and the results are reported here.

The dried leaves were successively extracted with warm petroleum ether, ether and alcohol. Chromatography of the unsaponifiable matter of the petroleum ether extract on alumina yielded a colourless waxy substance, m.p. 79.3–79.7°. It analysed for C_{26.28} H_{54.58}O, did not show evidence for unsaturation and formed an acetate m.p. 62–4°. These properties showed that it is "ceryl alcohol" (Piper *et al.*⁵). The ether extract of the leaves did not yield any worthwhile material.

The alcoholic extract was concentrated, diluted with water and extracted successively with benzene, ether and ethyl acetate. The last (ethyl acetate) extract gave a very hygroscopic solid which was purified by taking up in water and extracting with butanol. Treatment of the butanol concentrate with petroleum ether yielded a pale yellow solid which crystallised from alcohol as minute short prisms, m.p. 218–26°. Colour reactions showed that it was a flavonoid glycoside. Hydrolysis with hot 7% sulphuric acid yielded an aglycone which from its m.p. (276–78°), analysis, colour reactions, spectral data and the melting point of its acetate (178–81°) was identified as kempferol (3, 5, 7, 4'-tetrahydroxyflavone). The sugars were identified as D-glucose and L-rhamnose by paper chromatography.

The spectral properties of the parent glycoside including shifts with NaOAc, NaOEt, $AlCl_3$ and H_2BO_3 , combined with its colour reactions with zirconium oxychloride reagent with and without added citric and oxalic acids,⁶ showed that it had free hydroxyl groups at 5, 7 and 4'-positions. Hence both the sugar units should be linked to the 3-OH. The R_f values of the glycoside in (1) phenol water—upper phase, (2) lower phase, (3) butanol-acetic acid-water (4 : 1 : 5)—upper phase and (4) lower phase, and the m.p. of the acetate, 133–35° showed that the glycoside was most probably 3-O-rhamnoglucofuranoside of kaempferol.⁷ This was confirmed by direct spectral comparison with an authentic specimen (available in Prof. T. R. Seshadri's collection) in the visible and u.v. region, including shifts with all the reagents mentioned earlier; the agreement was complete.

The residual portion of the alcoholic extract of the leaves on standing for a few weeks deposited a colourless solid which could be crystallised from hot water. It was found to be potassium bitartrate.

The authors are grateful to Prof. T. R. Seshadri for his keen interest. One of the authors (V. S. I.) thanks the Government of India, Ministry of Education, for a Research Training Scholarship.

Chemistry Department, S. RANGASWAMI.
Delhi University, V. SUBRAMONI IYER.
Delhi-7, April 23, 1966.

1. *The Wealth of India, Raw Materials*, Council of Scientific and Industrial Research, New Delhi, 1956, 4, F-G, 137.
2. Earle, F. R., Glass, C. A., Geisinger, G. C. and Wolff, I. A., *J. Am. Oil Chemists' Soc.*, 1960, 37, 440.
3. Griffiths, T. A., *J. exptl. Botany*, 1962, 13, 169.
4. Nair, A. G. R. and Sankarasubramanian, S., *Curr. Sci.*, 1962, 31, 504.
5. Piper, S. H., Chibnall, A. C. and Williams, A. F., *Biochem. J.*, 1934, 28, 2175.
6. Höfhammer, L. and Hansel, R., *Arch. Pharm.*, 1954, 287, 34.
7. Murti, V. V. S., Raman, P. V., Seshadri, T. R. and Thakur, R. S., *J. Sci. Ind. Res. (India)*, 1962, 21B, 80.

INSENSITIVITY OF THE PREPUBERAL RHESUS MONKEY TESTIS TO SEROTONIN AND HISTAMINE

It has been reported that serotonin (5-hydroxy tryptamine) causes degeneration of the seminiferous epithelium of rats, the particular susceptible stages being the spermatocytes and the spermatids.¹ The weight of the genital organs is also reduced. Similar changes have been observed in the seminiferous epithelium of

mice after a single injection of serotonin and histamine, either alone or in combination.² In immature rats the ovarian response to exogenous gonadotrophin is inhibited by serotonin.³⁻⁴ The presence of histamine has been demonstrated in the genital organs of the male rat; the seminal vesicles and the ventral prostate contain high concentrations of the amine.⁵ The present communication is concerned with the effect of serotonin and histamine on the testis of prepuberal rhesus monkeys (*Macaca mulatta*).

Rhesus monkeys of the Institute primate colony weighing 1.7–2.6 kg. (4–6 months old) received serotonin (1.5 mg./kg.), histamine (1.5 mg./kg.) or their combination (1.5 mg./kg. serotonin + 1.5 mg./kg. histamine) by the subcutaneous route daily for 45 days. The control animals were injected with the solvent (0.2 ml. sterile distilled water) alone in a similar manner. All of the animals were maintained under uniform husbandry conditions throughout the experimental period.

The monkeys were sacrificed on the day following the last injection. The testis, seminal vesicle and the prostate were dissected out, weighed to the nearest 0.1 mg. in a Roller-Smith balance and then fixed in Bouin's fluid for histological study. Serial paraffin sections of the testis were stained with Ehrlich's hematoxylin and eosin.

The testes were located in the inguinal canal throughout the experimental period. The amines had no effect on the colouration of the circumgenital area which showed a consistent golden reddish tinge as in the controls.

It will be seen from Table I that histamine caused a significant decrease in testicular weight (*vs.* controls, $P < 0.01$), but serotonin *per se* or in combination with histamine had no effect. Histologically, the testis of control animals presented typical prepuberal features with compact small tubules which contained only spermatogonia and undifferentiated sustentacular cells. There was no mitotic activity in the tubular elements. The interstitium comprised reticulin fibres and fusiform cells with dark-stained nucleus arranged in rows around the tubules. The basement membrane was thin and barely perceptible. The tunica albuginea and the overall vascularity of the organ were inconspicuous. The histological picture of the testis of serotonin and/or histamine-treated animals was similar to that of the controls.

Only serotonin caused a significant increase in seminal vesicle weight (*vs.* controls, $P < 0.05$, Table I); histamine, serotonin or their combination had no effect on the prostatic weight.

TABLE I
Effect of serotonin and histamine on the genital organ weight of prepuberal male rhesus monkeys

Status	Testis weight (mg.)	Seminal vesicle weight (mg.)	Prostate weight (mg.)
Controls (5)*	258.0 ± 6.40†	334.0 ± 22.54	145.8 ± 7.86
Serotonin (5)	266.6 ± 24.30	421.0 ± 20.27	136.4 ± 15.33
Histamine (5)	223.0 ± 1.55	336.8 ± 16.85	118.0 ± 9.85
Serotonin + Histamine (5)	251.2 ± 16.15	346.0 ± 19.26	114.0 ± 12.54

* No. of animals; † Mean ± S.E.

The results of the present study show that serotonin and histamine have no noteworthy effect on the prepuberal rhesus monkey testis. It has been suggested that the degenerative changes evoked by serotonin in the testis of rats are due to ischemia of the vascular bed. Accordingly, the absence of a properly developed vasculature may be the root cause of failure of these amines to influence the testis of sexually immature monkeys.

This investigation was supported by a grant from the Ford Foundation. The authors are grateful to Dr. M. L. Dhar for his interest in this study.

Central Drug Research Inst., AMIYA B. KAR.
Lucknow, March 22, 1966. HARISH CHANDRA.

1. Bonatella, A. V., Salgado, E. D. and Alger, E. A., *Endocrinol.*, 1962, **71**, 827.
2. O'Steen, W. K., *Proc. Soc. Exp. Biol. Med.*, 1963, **113**, 141.
3. —, *Endocrinol.*, 1964, **74**, 885.
4. —, *IBID.*, 1965, **77**, 937.
5. Assaykeen, T. A. and Thomas, J. A., *Ibid.*, 1965, **76**, 539.

EXPERIMENTAL DEMONSTRATION OF THE LIFE-CYCLE OF *PHILOPHTHALMUS* SP. (TREMATODA: PHILOPHTHALMIDAE)

In the course of studies on larval Digenea from Andhra Pradesh it has been observed that the snail *Melanoides tuberculatus* (Müller) serves as a suitable host for many species of trematodes. 30% of *M. tuberculatus* collected from a stream near Waltair were observed to shed cercariae belonging to the well-known 'Megalura' group. This infection has been found to be fairly common throughout the year. The cercaria closely resembles *Cercariae Indicae* IV described by Sewell.⁷ However, Sewell was not

certain about the number of flame cells, of which he mentioned 14 pairs. In the present study 18 pairs of flame cells arranged in 6 groups of 3 each could be recognized.

The cercaria encysts readily on coming into contact with any hard object, on the bottom and sides of the container and the shell surface of the snail host, as well as at the surface of water. Encystment is hastened by mechanical stimulation such as shaking or stirring. The metacercarial cysts (Fig. 1) are flask-shaped

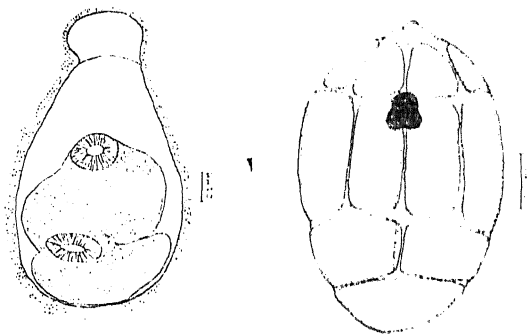


FIG. 1

FIG. 2

FIGS. 1-2. Fig. 1. Metacercarial cyst of *Philophthalmus* sp. Fig. 2. Miracidium of *Philophthalmus* sp. showing arrangement of the epidermal cells.

measuring 0.24×0.15 mm. The cyst wall is thin and transparent. The larva lies inside the cyst in a contracted and folded condition and shows very little or no movement. The excysted metacercaria measures 0.39 to 0.46 mm. in length by 0.12 to 0.18 mm. in breadth. The oral sucker is 0.052 to 0.072 by 0.052 to 0.064 mm. The prepharynx is smaller than in the cercaria and measures 0.012 to 0.024 mm. Pharynx is 0.032 to 0.04 mm. by 0.024 to 0.04 mm. Ventral sucker has a diameter ranging from 0.06 to 0.088 mm. The fore-body ranges from 0.2 to 0.22 mm. and the hind-body from 0.144 to 0.16 mm. in length.

To obtain the adult, experiments have been devised selecting laboratory-reared guinea pigs and hosts such as water-hen, rats and a seagull, captured in the field. Most successful results were obtained in guinea pigs. The procedure has been to collect metacercarial cysts in large numbers in a small volume of water and transfer them with the help of a fine brush into the orbit of the eye. Experimental hosts during this operation were sometimes anaesthetised. But this was found to be not quite necessary, because transference could be done by appropriate manipulation. These experiments revealed that the flukes reach

maturity at the end of 15 days, but the eggs produced on this day did not appear normal and viable. Flukes that have been removed from the orbit of guinea pigs on the 30th day were normal, well developed and yielded viable eggs containing fully developed miracidia. Flukes on removal from the orbit were examined alive in Ringer's solution. Eggs are released and miracidia soon hatch, but their survival time in Ringer's fluid is very short, being less than one hour. Eggs, which are transferred immediately to tap-water, yielded miracidia that remained active and alive for at least 4 hours. The miracidium (Fig. 2) measured 0.204 by 0.078 mm. and contained a fully developed redia. The epidermal formula has been found to be 6, 8, 4, 2 as revealed by the silver impregnation technique of Lynch.⁶

This is the first report on an experimental investigation into the life-cycle of the ocular trematode *Philophthalmus* sp. from India, although the 'Megalura' type of cercaria has been known from a very long time (see Sewell⁷). Elsewhere the complete life-cycle of *Philophthalmus gralli* Mathis and Leger 1910 has been investigated and reported upon by Alicata and Noda,² Ching,³ West⁴ and Alicata.¹ Fried⁴ and Fried and Penner⁵ described the stages in the life-cycle of *P. hegneri*.

I am grateful to Dr. K. Hanumantha Rao for guidance and helpful suggestions. Thanks are due to Prof. P. N. Ganapati for facilities and encouragement and to the C.S.I.R. for the award of a Research Fellowship.

Dept. of Zoology, A. SATYANARAYANA MURTY.
Andhra University,
Waltair, February 2, 1966.

1. Alicata, J. E., *J. Parasit.*, 1962, **48**, 47.
2. -- and Noda, K., *Tributo Homenaje al Dr. Eduardo Caballero y Caballero. Jubileo 1930-1960*, 1960, p. 67.
3. Ching, H. I., *Proc. Helm. Soc. Wash.*, 1961, **28**, 130.
4. Fried, B., *J. Parasit.*, 1962, **48**, 395.
5. -- and Penner, L. R., *Ibid.*, 1963, **49**, 978.
6. Lynch, J. E., *Quar. J. Microscop. Sci.*, 1933, **76**, 13.
7. Sewell, R. B. S., *Ind. J. Med. Res.*, 1922, Suppl. 1.
8. West, A. F., *Amer. Midland. Natur.*, 1961, **66**, 363.

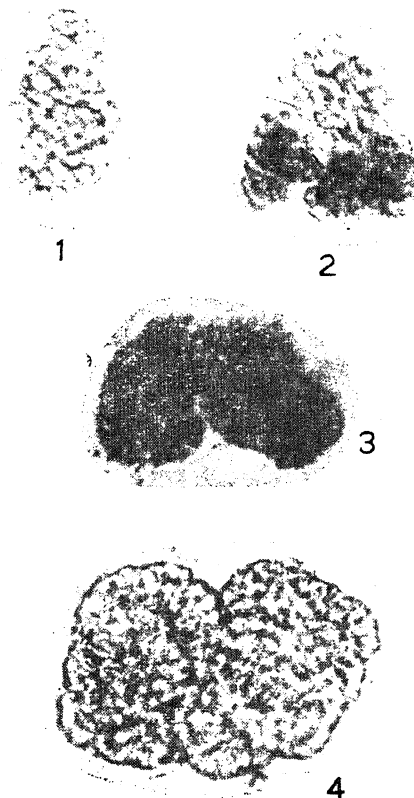
OCCURRENCE OF BOTRYOCOCCUS IN THE MIOCENE LIGNITE OF SOUTH ARCOT DISTRICT, MADRAS

MICROFOSSILS referable to the colonial oil forming alga *Botryococcus* have been recorded previously from India from the Intertrappean cherts of Mohagaonkalan,¹ Eocene lignites of Cutch² and Palana³ and Miocene lignite of Alleppey.⁴ Further, this alga was also reported

to occur in the upper Eocene Jaintia series of Assam.⁵ From outside India fossil *Botryococcus* have been recorded from North America, England, France, Germany and Australia from diverse horizons ranging from as early as Ordovician upto Pleistocene.^{6,7} Almost all the fossil specimens of this alga are identified with the modern species *B. braunii* Kützing.

The present contribution records the fairly common occurrence of colonies of *Botryococcus* recovered during an investigation of fossil spores and pollen, from the Neyveli lignite (Miocene) of South Arcot District in the Madras State.

The yellowish or brownish-yellow colonies are seen either singly or in aggregates. They are irregularly botryoidal in shape and are highly resistant to various apparently destructive treatments, viz., treatment with HF, HCl and Schultz's mixture and also boiling the lignite in 10% KOH.



FIGS. 1-4, $\times 550 \mu$.

The fossil colonies from the S. Arcot lignite (Figs. 1-4) vary from 35 to 105 μ in size (longest diam.) with the individual cells at the

periphery measuring $7.5 \times 2.7 \mu$. They are strikingly similar to the present-day *Botryococcus braunii*, a detailed description of which was given by Blackburn and Temperley.⁷ In the living condition each colony consists of pear-shaped or elliptical cells aligned radially at the periphery either singly or in twos or fours. Each cell is placed within a thin cuticular or waxy structure, the thimble which itself is embedded within a thicker cup-like sheath of fatty material. Further, each cell is capped by a cell cap of pectic and cellulosic substances. In the fossil condition usually the skeletal framework constituting the waxy or fatty thimbles and cups is preserved. The radial alignment of the pear-shaped or oval cells is also seen clearly in many of the specimens (Figs. 3 and 4). In those cases where the preservation of the alga is not satisfactory only a faint impression of the outlines of the thimbles and cups is seen and such colonies, on the whole, look like amorphous botryoidal structures.

The extreme antiquity of *Botryococcus*, when taken in conjunction with the pronounced uniformity in its structure, would clearly indicate that we are dealing with a taxon that has undergone little or no modification all through its extended geological history. *Botryococcus* occurs mostly as a member of the freshwater plankton in ponds, pools and lakes; it has also been reported from the brackish waters in Russia. Judging from the habitat of the living *Botryococcus* it is quite probable that the South Arcot lignite was deposited in quiet, open ponds or lakes of freshwaters. In this connection it may be significant to note that pollen grains referable to *Nymphaea*, *Potamogeton*, *Sparganium* and *Myriophyllum* have also been recovered from the same lignite.⁸

The author is grateful to Dr. C. V. Ratnam of the Neyveli Lignite Corporation Ltd. for the kind supply of lignite samples and to Prof. R. N. Singh of the Banaras Hindu University for his helpful suggestions in the identification of the fossil specimens. To Prof. M. R. Suxena the author is thankful for his kind interest and encouragement.

Department of Botany, C. G. K. RAMANUJAM.
Osmania University,
Hyderabad (A.P.), February 8, 1966.

5. Baksi, S. K., *Bull. Geol. Min. and Metall. Soc. Ind.*, 1962, No. 26, 6.
6. Travers, A., *Micropalaeontology*, 1955, 1, 343.
7. Blackburn, K. B. and Temperley, B. N., *Roy. Soc. Edin. Trans.*, 1936, 58, 841.
8. Ramanujam, C. G. K., *Pollen & Spores*, 1966, 8 (in press).

EMBRYO-SAC AND ENDOSPERM IN *ANDROGRAPHIS PANICULATA* NEES.

CRETE,¹ Maheshwari and Negi² and recently Mohan Ram³ have reviewed embryological work on Acanthaceae. The genus *Andrographis* belonging to the tribe Andrographideae of the subfamily Acanthioideae shows some of the embryological characters unique in the family Acanthaceae. The two species, *A. serpyllifolia* and *A. echinoides* so far studied by Mohan Ram⁴ show many characters common to each other but both differ from other members of the family except *Nelsonia* (Mohan Ram⁵) and *Elytraria* (Johri and Singh⁷) in having a ruminant persistent endosperm. The development of endosperm with prominent micropylar and chalazal haustoria is interesting in the genus and also in the family.

Because of the high medicinal value of *Andrographis paniculata* Nees, the present investigation was undertaken to explore the life-history which has not been worked out so far and to compare whether embryological peculiarities, if any, are similar to those recorded in other species of *Andrographis*.

The ovules are anatropous, unitegmie and tenuinucellate. A single layer nucellus degenerates simultaneously with micropylar megaspores and embryo-sac becomes directly surrounded by integument. A distinct jaculator is present. A single hypodermal archesporial cell functions directly as megaspore mother cell (Figs. 1 and 2). The chalazal megaspore of the linear tetrad develops to organise an eight nucleate embryo-sac (Fig. 3). The mature embryo-sac appears like a fish with a bifid tail. It has a flattened micropylar part with egg apparatus and bifurcated chalazal part containing antipodals at one of the ends (Fig. 4). Both the synergids degenerate soon after fertilization. The three antipodal cells are richly cytoplasmic, however, some of them are binucleate as recorded in *Elytraria* (Johri and Singh⁷). Antipodals also disappear soon after the fertilization (Fig. 5).

The endosperm has three distinct parts; a proximal micropylar haustorium with two prominent dark staining nuclei, a binucleate chalazal haustorium and a main central cellular

1. Singhai, L. C., *Abst. Ind. Sci. Cong. 44th Session*, 1957, Pt. 3, 297.
2. Vimal, K. P., *Curr. Sci.*, 1953, 22, 375.
3. Rao, S. R. N. and Misra, S. S., *Ibid.*, 1949, 18, 380.
4. Chandra, A., *Ibid.*, 1964, 33, 214.

endosperm (Fig. 6). The micropylar haustorium occupies more than the half anterior part of the embryo-sac and lodges within it the massive suspensor of the embryo (Fig. 7). The chalazal haustorium, densely packed with cytoplasm, appears conical and occupies one side of the distal part of the embryo-sac (Fig. 8). The

later development of the endosperm. Their dense cytoplasm, prominent nuclei and papillar outgrowths suggest their possible haustorial role. The growth of the endosperm towards peripheral side is irregular later on, as a result it becomes ruminate. The cells of the mature endosperm persisting in seed show thickened walls.

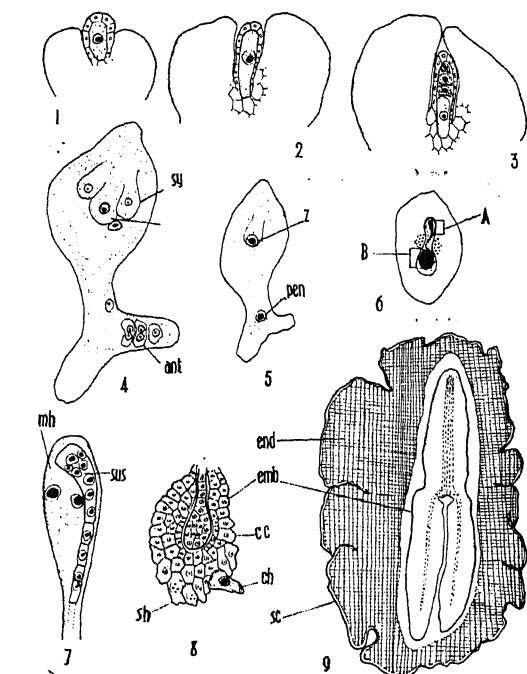
The embryo is filamentous with long uniseriate suspensor cells. The basal cells of the suspensor are much swollen and have many nuclei embedded in the dense cytoplasm (Fig. 7). The coenocytic suspensor cells become well marked at globular stage of embryo. Finally a typical dicotyledonous embryo is formed (Fig. 9).

The mature seed is almost naked. The entire integument is consumed by the developing endosperm and as a result there is no distinct layer of seed coat except the remnants of epidermal layer. It is the ultimate shape of the endosperm which determines the shape of the seed which has a corrugated surface (Fig. 9).

Andrographis paniculata shows more or less all important characters common to the other two species, *A. serpyllifolia* and *A. echinoides* making the genus *Andrographis* unique in the family in having; (i) fish-shaped mature embryo-sac, (ii) coenocytic micropylar and chalazal haustoria, (iii) cellular secondary haustoria, (iv) large multinucleate suspensor cells and (v) persistent ruminate endosperm in mature seed. A set of these quite peculiar characters found together in the genus *Andrographis* is uncommon in the family Acanthaceae and may be taken for distinct identification of the genus on embryological grounds and may prove to be of phylogenetic significance.

Sincere thanks are due to Dr. S. N. Dixit for guidance, Prof. K. S. Bhargava for facilities and the University Grants Commission for financial assistance.

Department of Botany, B. G. SAHL.
University of Gorakhpur,
Gorakhpur (U.P.), February 8, 1966.



FIGS. 1-9. Fig. 1. L.S. unitemic ovule showing Archesporium, $\times 89$. Fig. 2. L.S. ovule showing megaspore mother cell, $\times 89$. Fig. 3. L.S. ovule with linear megaspore tetrad. Note chalazal functioning megaspore, $\times 89$. Fig. 4. Mature embryo-sac showing egg apparatus, antipodals and polars. Note two antipodal cells being binucleate, $\times 171$. Fig. 5. Embryo-sac with fertilized egg and primary endosperm nucleus, $\times 62$. Fig. 6. L.S. ovule at globular stage of the embryo, $\times 14$. Fig. 7. Part 'A' of Fig. 6 enlarged, to show binucleate micropylar haustorium and multinucleate suspensor cells, $\times 89$. Fig. 8. Part 'B' of Fig. 6 enlarged to show cellular endosperm, chalazal haustorium and secondary haustoria, $\times 89$. Fig. 9. L.S. seed showing persistent and ruminate endosperm with mature embryo, $\times 11$. (ant, antipodals; cc, central chamber; ch, chalazal haustorium; eg, egg; emb, embryo; end, endosperm; mh, micropylar haustorium; pen, primary endosperm nucleus; sc, seedcoat; sh, secondary haustoria; sus, suspensor; sy, synergids; z, zygote.)

main body of the endosperm is cellular. By the time the embryo attains globular shape the distal marginal cells of the endosperm become enlarged and appear haustorial in nature. Some of the nuclei of cells of this region show two, three or four nucleoli which degenerate during

1. Crete, P., *Ann. Sci. Nat. (Bot.) 11e Ser.*, 1951, 12, 131.
2. Maheshwari, P. and Negi, V., *Phytomorph.*, 1955, 5, 456.
3. Mohan Ram, H. Y., *Ibid.*, 1964, 14, 388.
4. —, *American J. Bot.*, 1960 a, 47, 215.
5. —, *Curr. Sci.*, 1962, 31, 7.
6. —, *Phytomorph.*, 1963, 13, 82.
7. Johri, B. M. and Singh, H., *Bot. Notiser*, 1959, 122, 227.

A NEW SPECIES OF *MICROSPHAERA* ON *HAMILTONIA SUAVEOLENS* ROXB.

Hamiltonia suaveolens Roxb. (Family Rubiaceae) is a wild dichotomously branched under-shrub, 4-12 feet high with spreading branches, elliptical to lanceolate or ovate leaves and white or blue flowers. It is present on the dry rocky hills, at an altitude of 2,000-5,000 ft. in the tropical and sub-tropical regions of the country including Himalayas, Central India and Western peninsula.

Probably no disease has been reported on this genus till now. A powdery mildew had been collected from Sajjangarh hills near Udaipur and was identified as *Microsphaera*. Since the fungus has never been recorded on the host a brief description of the causal organism and the symptoms are given below.

Mildew appears on the upper surface of the leaves as small, circular, white spots. These enlarge rapidly and cover the entire surface of the leaf as dirty white growth with numerous minute black bodies scattered all over the area.

Mycelium septate, superficial attached to the leaves by appresoria. Conidiophores erect, simple and septate bearing catenulate single-celled, hyaline, oblong to elliptical conidia measuring 30-50 (40 μ) \times 13-20 (18 μ).

Cleistothecia dark, spherical superficially placed in the mycelial matrix bearing numerous, long and septate appendages which are branched dichotomously at the apex (dichotomy of 3-5 stages observed); perithecia measure 85-138 (117 μ) in diameter. Each cleistothecium contains globose to dacryoid, 4-12 (4 to 8 commonly asci measuring 54-88 (69 μ) \times 34-64 (34 μ) and containing 4-6 ascospores.

Ascospores single-celled, hyaline, round to oblong and measure 17-34 (25 μ) \times 14-20 (17 μ).

On the green leaves of *Hamiltonia suaveolens* Roxb.; 17th January, 1964; Sajjangarh, Udaipur; leg M. K. Bhatnagar and K. L. Kothari.

Type specimen deposited at CMI, Surrey, England, (IMI 108172).

Mycelium septatum, superficiale, per appresoria foliis fixum. Conidiophora erecta, s-implicia et septata, producentia conidia unicellularia, hyalina, oblonga vel elliptica, catenulata 30-50 (40 μ) \times 13-20 (18 μ). cleistothecia fusca sphaerica superficialiter posita in matrice myceliali ferantia appendices plures longas septatas, quae dichotome ramificantur ad apicem (dichotomia terna-quina notata); perithecia 85-138 (117 μ) diam. Singula cleistothecia continent ascos globosos vel dacryoideos 4-12, vulgo 4-8, quorum magnitudo est 54-88 (69 μ) \times 34-64 (34 μ); asci 4-6

ascospori. Ascopora unicellulares, hyalinae, rotundae vel oblongae, 17-34 (25 μ) \times 14-20 (17 μ).

In foliis viridibus *Hamiltoniae suaveolentiae* Roxb. die 17 januarii, 1964; Sajjangarh, Udaipur; leg. M. K. Bh. & K. L. K. et positus in CMI, Surrey in Anglia sub numero 108172.

Since no record of the powdery mildew has been found on *Hamiltonia suaveolens* the fungus is described as a new species—*Microsphaera prasadii* sp. nov.

Thanks are due to Dr. J. C. F. Hopkins and Dr. K. Pirozynski of CMI, England, for identification and confirmation, Rev. Fr. Dr. H. Santapau, Director, Botanical Survey of India, for preparing the Latin diagnosis and Dr. B. K. Srivastava, Director, Agricultural Experiment Station, for facilities.

Agric. Experiment Station, M. K. BHATNAGAR.
University of Udaipur, K. L. KOTHARI.
Udaipur (Rajasthan),
March 12, 1965.

ALTERNARIA TAGETICA SP. NOV. CAUSING BLIGHT OF MARIGOLD (TAGETIS SP.)

DURING December 1964 an infection of marigold (*Tagetis* sp.—Sutton's African Giant variety) by *Alternaria* sp. was observed in the Floriculture Gardens of Faculty of Agriculture, University of Kalyani. The plants transplanted from the seedbed in the first week of November showed after 6-7 weeks irregular brownish spots on the leaflets followed by stems and branches. The spots, circular to oblong, brownish at first, later turn dark brown to blackish, enlarge, coalesce to cover almost the entire leaves and part of the branches giving the plant a burnt up appearance. On blooming the inflorescence axis and flower-heads are attacked severely turning the original yellow colour of the flowers to deep brown or black presenting thereby a scorched picture. Edwards¹ reported a somewhat parallel affliction of *Tagetis erecta* limited only to the leaves and flowers caused by *Alternaria zinniae* Pape. The present infection is systemic in nature and detailed morphological and physiochemical study of the pathogen indicated it to be different from all the known species of *Alternaria*. The pathogen is, therefore, described as *Alternaria tagetica* sp. nov.

Alternaria tagetica Sp. Nov. SHOME AND
MUSTAFAEE

Hyphae leves, valde ramosae, clare vel obscure brunneae, 3.7-5.5 μ diam Conidiophori erecti,

glomerati, haud ramosi, simpliciter vel obscure brunnei, septati, 1-6 septos habentes, $37.2-124 \mu \times 6.2-9.3 \mu$, cellulis basalibus leviter laxis atque apice rhomboide, in quo, autem, punctum ligationis conidiorum apparet, praediti. Conidia catenulata, muriformia, ante maturitatem 3-9 transversaliter, 1-4 longitudinaliter, post, autem, 8-14 transversaliter, 3-6 longitudinaliter septata, nigro-brunnea, $43.4-384.4 \mu$ longa, $8.4-33.6 \mu$ lata, aliquando $186-217 \mu \times 8.6-31.0 \mu$, latiora ad medium, ex utraque parte terminaliter acuta, basaliter sphaerica, apicaliter, autem structuram aliquam tanquam rostrum ostendentia, usque 291.0μ . Germinatio quibusvis in corpore conidiorum cellulis fit.

Non difficiliter in cultibus P.D.A., Czapeck-dox, Sabourauds, Synthetis et similibus, progenies obtinentur, etsi sporulationem in quibuslibet eorum perdat.

Alternaria tagetica sp. nov.—Hyphae smooth, septate, profusely branched, light to dark brown in colour, $3.7-5.5 \mu$ in diameter.

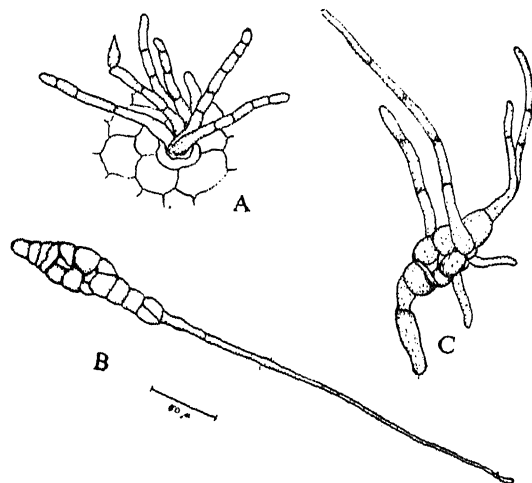


FIG. 1. A. Conidiophore. B. Conidia with apical beak. C. Germinating conidia.

Conidiophore erect, grouped, unbranched (Fig. 1 A), brown to dark brown, septate (1-6 septa), $37.2-124.0 \mu \times 6.2-9.3 \mu$. Basal cell slightly broader and the apical portion ending in a blunt showing the presence of scar indicating the point of attachment of conidia.

Conidia in chains, muriform, with 3-9 transverse and 1-4 longitudinal septa in younger and 8-14 transverse and 3-6 longitudinal in the older ones. Conidia deep brown in colour, $43.4-384.4 \mu$ long and $8.4-33.6 \mu$ wide but mostly

$186-217 \mu \times 8.6-31.0 \mu$, show a wide central part tapering at both ends, the basal portion is rounded whereas the apical part ends up into a long-drawn beak-like structure (Fig. 1 B) measuring upto 291.0μ . Germination by any of the cells (Fig. 1 C).

On plants of *Tagetis* sp., Floriculture Gardens, University of Kalyani, January 1965. Specimen in the Department of Plant Pathology, University of Kalyani, India, Herb. No. A.F.P.P.H. 104.

Our thanks are due to Prof. A. Chaves Batista, Director, I.M.U.R., Recife, Brasil, for his help in the identification of the fungus and to Dr. F. B. Leal for rendering the specific diagnosis in Latin.

Department of Plant Pathology, S. K. SHOME.
Faculty of Agriculture, T. P. MUSTAFEE.
University of Kalyani,
Mohanpur, West Bengal,
India, June 26, 1965.

1. Edwards, J. C., *Sci. and Cult.*, 1957, 22 (12), 683.

TRYBLIDIELLA RUFULA (SPRENG.) SACC. CAUSING CANKER AND DIE- BACK OF LIME IN RAJASTHAN AND ITS SYSTEMATIC POSITION*

Twigs of lime (*Citrus aurantifolia* Swingle) plants were found dead in a few orchards in the State and raised, rough pin-head-like bulgings were present on their entire surfaces scattered irregularly. On microscopic examination these pin-head-like structures were found to contain asci and ascospores. The bulgings were the apothecia 0.3 to 1.0 mm. in length, hard, black, elliptical or ovate, carbonous, opening by narrow clefts, separating very rarely, cespitose, with no stroma (Fig. 1). Asci elonga-

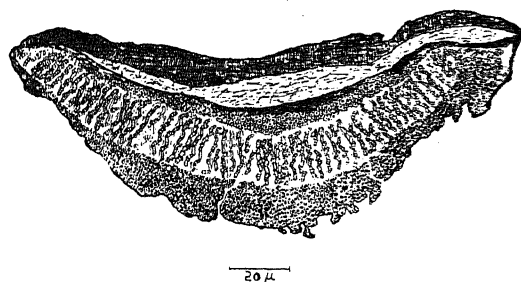


FIG. 1. *Tryblidiella rufula* Section through apothecium.

ted, cylindrical with abundant clavate tipped paraphyses, hyaline to yellowish-brown, eight-spored, measuring $113.5-138.0 \times 9.0-11.5 \mu$.

Ascospores uniseriate, oblong, three-septate, slightly constricted at the septa and bent; smooth thick-walled dispersing from the ascus through an apical pore at maturity, measuring 17.9-21.0 μ \times 7.5-9.5 μ . Hypothecium well developed.

On the basis of characters described above the fungus has been identified as *Tryblidiella rufula* (Spreng.) Sacc. of Ascomycetes. Deighton (1936) recorded this fungus on lime twigs in Sierra Leone. In India *T. rufula* is reported on branches of citrus species from Travancore-Cochin, Dehra Dun, Bihar, Bombay and Madras (Sydow and Butler, 1911). Ghosh and Dutta (1962) described the fungus on twigs of lime from Cuttack and Dwivedi (1962) from Varanasi. This fungus is for the most part considered to be saprophytic in nature, occurring on dead limbs, but in a few collections made by the senior author, it appeared to function as wound parasite and exhibited the symptoms of canker and die-back on lime twigs.

The lack of agreement in the literature on the taxonomic treatment of the genus *Tryblidiella* prevailed even during early times when Saccardo (1883) included in his description of the genus *Tryblidiella* a group of Discomycetes having brown ascospores with two or more septa. But Ellis and Everhart (1892) reduced the genus *Tryblidiella* to a sub-genus of *Tryblidium*. Later Rehm (1904) included one-septate brown-spored species under *Tryblidiella*, sub-genus *Eutryblidiella* and 3-5-septate brown-spored species under sub-genus *Rhydithysterium*. In 1939, Voorhees stated that those forms having brown 3-septate ascospores belong to the genus *Tryblidiella*. Clements and Shear (1957) have placed this genus under two distinct orders, viz., Phacidiales and Pezizales. In Phacidiales it may be placed under the family Hysteriaceae which is characterised by dark apothecium opening by a narrow cleft but it has more affinity with the family Tryblidiaceae which differs from the former only in the better-developed hypothecium. It is also represented in family

Dermateaceae of Pezizales and in neither case is the line a sharp one. Clements and Shear (1957) were hesitant in transferring this genus to any of these families completely and they maintained equal status of the genus both in Hysteriaceae and Dermateaceae. After a critical study, it is opined that the genus should now be referred to Hysteriaceae owing to the tendency of apothecia opening by a narrow cleft.

Sincere thanks are due to Shri T. C. Kala, Director of Agriculture, Rajasthan, for facilities.

Plant Pathological Lab., G. C. BHATNAGAR.†
Dept. of Agriculture, N. PRASAD.‡
Rajasthan, July 23, 1965.

* Part of the thesis for Ph.D. at Rajasthan University, of the senior author.

† Present address: 1. Asstt. Plant Pathologist, Regional Research Station, Banswara. 2. Dean, College of Agriculture, Jobner (Jaipur).

1. Clements, E. and Shear, L., *The Genera of Fungi*, Hafner Publishing Co., New York, 1957.
2. Deighton, F. C., *Mycological Work. Rep. Dep. Agri. S. Leone*, 1936, 1934, 18.
2. Dwivedi, R. S., "Some new records of Ascomycetes from India," *Proc. Nat. Acad. Sci.*, 1962, 32 (4), 345.
4. Ellis, J. B. and Everhart, B. M., *North American Pyrenomyces*, 1892, p. 689.
5. Ghosh, G. R. and Dutta, B. G., "Newly reported fungi from Orissa," *49th Proc. Ind. Sci. Cong.*, 1962, III.
6. Rehm, H., "Revision der Gattungen *Tryblidiella* Sacc., *Rhydithysterium* Speg., *Tryblidaria* Sacc., *Tryblidium* Rehm, *Tryblidiopsis* Karst," *Ann. Mycol.*, 1904, 2, 522.
7. Saccardo, P. A., *Sylloge Fungorum*, 1883, 2, 757.
8. Sydow, H. and Butler, E. J., "Fungi Indiae orientalis —Part III," *Ann. Mycol.*, 1911, 9, 372.
9. Voorhees, R. K., "The validity and morphology of two *Tryblidiella* species," *Mycologia*, 1939, 2, XXI, 113.

§ Original not seen.

REVIEWS AND NOTICES OF BOOKS

The Many-Electron Problem. By K. S. Viswanathan. (Asia Publishing House, Bombay), 1966. Pp. viii + 244. Price Rs. 22.00.

During the last decade, there has been a spectacular revival of interest in the many-body problem, which covers a wide spectrum of topics in atomic, molecular and solid state physics, nuclear physics as well as quantum chemistry. This book presents a systematic and coherent account of the mathematical methods developed to treat systems containing a large number of electrons. The first six chapters deal with the self-consistent field method, the Hartree-Fock equations and correlation effects in atomic and molecular systems. The correlation problem is again continued in the last chapter, which treats the long-range Coulomb interactions of electrons in a metallic, lattice, and the collective or the plasma oscillations. The chapters on two-electron systems present the most accurate and recent calculations made with electronic digital computers for the hydrogen molecule and the helium-like ions. Besides, there are two chapters dealing with relativistic corrections, second quantization, perturbation methods and Green's functions.

Dr. K. S. Viswanathan is a Scientist in the National Aeronautical Laboratory, Bangalore. He was formerly in the Raman Research Institute, first as a Research Fellow and later as the Assistant Professor of Theoretical Physics. Dr. Viswanathan is a Fellow of the Indian Academy of Sciences and an author of several scientific papers in crystal dynamics, many-body problem and space physics. C. V. R.

Advances in Mathematics (Vol. 1), Fascicle 3. Edited by Herbert Busemann. (Academic Press, New York and London), 1965. Pp. 265 to 450. Price \$ 6.50.

This publication provides the active research mathematician with a long-needed, effective means of communicating the most recent developments in his particular area of specialisation to his colleagues and to scientists in related fields.

The contents of this volume are as follows : E. Cartan's Geometric Theory of Partial Differential Equations, by Robert Hermann ; Spaces of Continuous Functions on Compact Sets, by

Zbigniew Semadeni ; Quasigroups, Nets, and Nomograms, by F. Aczel. C. V. R.

Structure and Evolution of the Stars. By Martin Schwarzschild. (Dover Publications, Inc., New York), 1965. Pp. xvii + 296. Price \$ 2.25.

The introduction of nuclear physics into astronomy and the use of new spectrographic and photoelectric techniques have caused profound changes in theoretical and observational research on the stellar interior. Written in 1957 by the Eugene Higgins, Professor of Astronomy at Princeton University, this important study is a summary of stellar evolution theory and offers full descriptions of the methods employed and results obtained in the significant new investigations in this field.

The titles of the chapters contained in this edition are : I. Observational Basis ; II. Physical State of the Stellar Interior ; III. Mathematical Techniques ; IV. Initial Stellar Structure ; V. Early Evolutionary Phases ; VI. Advanced Evolutionary Phases ; VII. Final Stellar Structure ; VIII. Summary and Review.

This book is a major contribution to our understanding of the structure and evolution of the stars. A basic text for all students directly concerned with the theory of the stellar interior, Professor Schwarzschild's study is also valuable for observational astronomers, applied mathematicians, and stellar physicists. C. V. R.

Documents on Modern Physics. Edited by Elliott W. Montroll, Institute for Defense Analyses ; George H. Vineyard, Brookhaven National Laboratory, Maurice Lévy, Université de Paris.

A new series published in inexpensive paperback and cloth-bound editions which make available selected surveys, lecture notes, conference proceedings and important collections of research papers in branches of physics of special current interest. The intended audience is comprised of senior undergraduate and graduate students and professional experimental and theoretical physicists. Prices range from \$ 1.95 to \$ 3.95 in the paperback editions and from \$ 3.95 to 6.95 in the clothbound editions,

1. *Neutrino Astrophysics*. By Hong-Yee Chiu. (Gordon and Breach, Science Publishers, Inc., New York), 1965. Pp. 115. Price: Cloth \$ 5.00; Paper \$ 2.50.

The contents of this book are as follows:

1. Introduction; 2. General Properties of a Star; 3. Equations of Stellar Structure; 4. Nuclear Reactions; 5. The Hertzsprung-Russell Diagram; 6. Neutrino Processes; 7. Introduction to General Relativity; 8. Neutron Stars; 9. A Word about Cosmology; 10. Summary.

2. *Dielectrics—Intermolecular Forces—Optical Rotation*. By John G. Kirkwood. Edited by R. H. Cole, Brown University. (Gordon and Breach, Science Publishers, Inc., New York), 1965. Pp. 282. Price: Paper \$ 4.95; Cloth \$ 8.50.

The contents of this book are as follows:

- I. The Dielectric Constant of Carbon Dioxide as a Function of Temperature and Density, with Frederick G. Keyes; II. The Dielectric Constant of Ammonia as a Function of Temperature and Density, with Frederick G. Keyes; III. The Dependence of the Dielectric Constants of Gases on Temperature and Density, with H. H. Uhlig and F. G. Keyes; IV. The Intramolecular Field and the Dielectric Constant; V. On the Theory of Dielectric Polarization; VI. The Dielectric Polarization of Polar Liquids; VII. On Phase Changes in Crystals Arising from Hindered Molecular Rotation; VIII. The Local Field in Dielectrics; IX. The Influence of Hindered Molecular Rotation on the Dielectric Constants of Water, Alcohols and other Polar Liquids, with Gerald Oster; X. The Influence of Hindered Molecular Rotation on the Dielectric Polarization of Polar Liquids; XI. Electrical Properties of Solids: Dipole Moments in Polyvinyl Chloride-Diphenyl Systems, with Raymond M. Fuoss; XII. Anomalous Dispersion and Dielectric Loss in Polar Polymers, with R. M. Fuoss; XIII. Anomalous Dielectric Dispersion in Polar Macromolecular Solutions, with W. G. Hammerle; XIV. Dielectric Dispersion of Polyvinyl Acetate in Toluene, with G. W. Hammerle; XV. The van der Waals Forces in Gases, with John C. Slater; XVI. The Equation of State of Helium, with Frederick G. Keyes; XVII. Einfluss der Quantisierung auf die Berechnung von Virialkoeffizienten; XVIII. Polarisierbarkeiten, Suszeptibilitäten und van der Waalssche Kräfte der Atome mit mehreren Elektronen; XIX. Statistical Theory of Low Frequency Intermolecular Forces; XX. Drude-Model Calculation of Dispersion Forces; XXI. Drude-Model Calculation of Dispersion Forces,

with W. L. Bade; XXII. On the Theory of Optical Rotatory Power; XXIII. Remarks on the Theory of Optical Activity; XXIV. The Absolute Configuration of Optically Active Molecules; XXV. The Theoretical Optical Rotation of Phenanthro [3, 4-c] Phenanthrene; XXVI. The Optical Rotatory Power of Helical Molecules; XXVII. The Optical Rotatory Power of Polyamino Acids and Proteins; XXVIII. Critique of the Theory of Optical Activity of Helical Polymers; XXIX. The Optical Rotatory Dispersion of the α -Helix. C. V. R.

-
- Theory of Elasticity*. By M. Filonenko-Borodich. (Dover Publications, Inc., New York), 1965. Pp. 378. Price \$ 1.75.

This Dover edition, first published in 1965, is an abridged and unaltered republication of the work first published by the Foreign Languages Publishing House, Moscow. This book has been translated from the Russian by M. Konayeva.

This volume by one of the foremost Russian physicists provides an exceptionally clear, well-organized exposition of the classical theory of elasticity and of standard methods used to solve elasticity problems. It fills a gap in technical literature in providing an intermediate coverage that is both wide in scope and thorough. It is suitable for text-book use, supplementary study, or for review.

Three introductory chapters provide an exposition of the theories of stress and strain and of Hooke's law. The text then continues to more complex problems of elasticity, presenting several basic equations: Navier's equations; Cauchy's equations; Saint-Venant's principle; Lamé's equations. Elasticity problems such as vibrations of a bar, torsion of a circular bar, and bending of a prismatical bar are then solved in terms of displacements and stresses. The category of plane problems is next taken up, in both Cartesian and polar co-ordinates. Such problems as plane stress and strain, bending of a cantilever, the effect of a concentrated force, and problems of a wedge loaded at the vertex are discussed. Other general methods of solving elasticity problems are given, including the use of harmonic and biharmonic functions, plane problems solved by means of functions of a complex variable, and treatments of the wave equation. Plate problems are introduced, specifically: bending and torsion and circular plates, and problems of an elliptic plate clamped at the edge. The final chapter deals with variational principles as alternatives to the differential equation method.

The author's approach is mathematical rather than experimental, and his development of topics is full and explicit. Some mathematical background is required of the reader, since it is presupposed that he has studied ordinary and partial differential equations. C. V. R.

Underwater Explosions. By Robert H. Cole. (Dover Publications, Inc., New York). Pp. ix + 437. Price \$ 2.75.

This book is an unabridged and unaltered republication of 1948 edition.

This classic study, based largely on the research activities carried out during World War II, is a valuable reference work on underwater explosions. Although this book dates from 1948, Cole's *Underwater Explosions* offers basic information which is just as important today as when it was written. Since it is the most comprehensive source of information in the field, today's hydrodynamicists and engineers concerned with underwater explosions must still rely heavily upon Cole's basic text.

The author treats both the theoretical and experimental aspects of the subject with great thoroughness and lucidity.

The contents of this book are: The Sequence of Events in an Underwater Explosion; Hydrodynamical Relations; The Detonation Process in Explosives; Theory of the Shock Wave; Measurement of Underwater Explosion Pressures; Photography of Underwater Explosions; Shock Wave Measurements; Motion of the Gas Sphere; Secondary Pressure Waves; Surface and Other Effects. C. V. R.

The Life of the Cell: Its Nature, Origin and Development. By J. A. V. Butler. (George Allen and Unwin Ltd., Ruskin House, 40, Museum Street, London, W.C. 1), 1966. Pp. 168. Price: Paper 21 sh.; Cloth 30 sh.

In this book Professor Butler continues the story of the living cell, giving in simple language an accurate account of many of the great developments of recent years. He also discusses the conclusion to be drawn from the new knowledge about the origin of life, the place of life in the universe and evolutionary process.

The titles of the chapters contained in this book are as follows: 1. Constituents of Living Organisms; 2. The Architecture of Proteins; 3. DNA and Cell Division; 4. The Manufacture of Proteins; 5. Viruses; 6. More about Protein Synthesis; 7. Mutations; 8. Genetics of Microorganisms; 9. Photosynthesis; 10. The Origin

of Life; 11. How Large Organisms are Built; 12. Antibiotics; 13. Antibodies and Immunity; 14. Disordered Growth—Cancer; 15. Sense Organs, Nerves and Muscles; 16. The Brain; 17. Life in the Universe. C. V. R.

Crustaceans. By Waldo L. Schmitt. (Ann Arbor, The University of Michigan Press), 1965. Pp. 204. Price \$ 1.95.

Crustaceans vary from the most succulent lobsters to the tiniest wood lice and sand fleas. This book explains what these creatures have in common—how they are born, live, love and die and what they mean to the history and economy of man. Here you will meet such "personalities" as the powerful South Sea robber crab who opens and eats coconuts; ill-fated barnacles that live only to breed and cannot eat; and the brine-loving shrimp *Artemia*, the only animal to flourish in the Great.

Research associate at the Smithsonian Institution, Waldo L. Schmitt was curator of the Division of Marine Invertebrates at the U.S. National Museum for twenty-three years. He has travelled to the four corners of the globe to collect first-hand knowledge about crustaceans.

The titles of the articles contained in this book are as follows: I. Body Organization and Functions; II. The Family Album, Part I; III. The Family Album, Part II; IV. Crustacean Habits and Homes; V. Crustacean Conversation; VI. Light and Color in Crustaceans; VII. Crustaceans as Food and Medicine; VIII. The Sins of Crustaceans. C. V. R.

Advances in Heterocyclic Chemistry (Vol. III).

Edited by A. R. Katritzky. (Academic Press, New York and London), 1964. Pp. 421. Price \$ 13.00.

Following the two previous volumes (for reviews see *Current Science*, 1964, 33, p. 159 and p. 414), the present volume continues to review the vast new information in the field of Heterocyclic Chemistry. There are three chapters dealing with specific groups of compounds, namely, Carbolines by R. A. Abramovitch and I. D. Spenser; 1, 2, 3, 4-Thiaziazoles by K. A. Jensen and C. Pedersen; Pentazoles by Ivar Ugi.

The review articles on carbolines is the major chapter (pp. 79–208) in the book. It was Perkin and Robinson who in 1919 introduced the name carboline for the ring system—benzene-pyrrole-pyridine—which was encountered for the first time in the harmala alkaloids. Since then the

nomenclature and numbering of this system of compounds have gone through an astonishing variety of ways. The renewed interest within the last decade in the chemistry of carboline^s may be said as due to the discovery of serotonin and to developments in the chemistry and pharmacology of the Rauwolfia and related alkaloids. In this comprehensive article on carboline the authors deal, among other things, with the synthetic methods leading to the different oxidation states of the carboline ring systems and their interconversion, the reactions at carbon and at nitrogen of fully aromatic carboline^s and their reduced and oxidized derivatives, nuclear rearrangements and the biogenesis and biosynthesis of naturally occurring carboline^s.

In the article on thiatriazoles the authors review work leading to the correctness of their structure, discuss their syntheses and chemical properties, deal with thiatriazoles substituted with C-radicals, thiatriazole-5-thiol and its derivatives. The short articles on Pentazoles reviews work on arylpentazoles, their characterization and their formation and decomposition.

The remaining four chapters of the volume deal with topics of general interest in heterocyclic chemistry. They are: The Quaternization of Heterocyclics, by G. F. Duffin; Carbene Reactions, by C. W. Rees and C. E. Smithen; Applications of the Hammett Equation, by H. H. Jaffe and H. Lloyd Jones; and Nucleophilic Heteroaromatic Substitution, by G. Illuminati.
A. S. G.

High Energy Nuclear Reactions. By A. B. Clegg. (Clarendon Press, Oxford), 1965. Pp. 130. Price 18 sh.

The study of simple reactions of nucleons of 100 MeV and above with light nuclei has attracted much attention in recent years. At these energies the wavelength of the incident nucleon becomes comparable with the inter-nucleon distances in the nucleus and the interaction involves only one collision to excite the nucleus. Reactions leading to different excited states may be considered as made up of successive collisions with individual nucleons. Such reactions with simple characteristic features have proved useful in the study of the structure of light nuclei.

The author, who is well known for his researches in the field, discusses in the first

two chapters the general aspects of nuclear reaction mechanisms and the techniques used to obtain experimental data on cross-sections, polarizations, etc. The next four chapters are devoted respectively to the four classes of reactions, namely, elastic scattering, inelastic scattering, nucleon knockout reactions and cluster knockout reactions.
A. S. G.

Organometallic Syntheses. Edited by John J. Eisch and R. Bruce King. Volume I: *Transition-Metal Compounds.* By R. Bruce King. (Academic Press, Inc., 111, Fifth Avenue, New York), 1965. Pp. 186. Price \$ 6.50.

Compounds containing carbon-metal bonds have come to occupy a prominent position in modern chemical research. Organometallic compounds have served as key reagents in many major synthetic achievements both in organic and in inorganic chemistry. Specialized techniques are involved in the preparation and handling of these substances. References about them are scattered in various journals. Hence this venture by the Academic Press to bring out a Series on *Organometallic Syntheses* which will form a reliable reference and guide book to chemists in this field of work will be welcomed by them.

The first volume under review is on transition-metal compounds by R. Bruce King. It is in two parts. In Part I the author discusses the most essential features of the experimental techniques necessary in preparative organometallic chemistry. Part II contains a detailed description of the syntheses of over sixty compounds.
A. S. G.

Books Received

Advances in Marine Biology. Edited by Sir Frederick S. Russell. (Academic Press, Inc., Lond. Ltd., London W. 1), 1965. Pp. x + 402. Price 84 sh.

The International Encyclopedia on Physical Chemistry and Chemical Physics—Ionic Equilibria. By J. E. Prue. (Pergamon Press, Oxford), 1966. Pp. xiv + 115. Price 35 sh.

Scientific Societies in the United States (3rd Edition). By R. S. Bates. (Pergamon Press, Headington Hill Hall, Oxford), 1965. Pp. 326. Price 63 sh.

SUMMER SCHOOL ON ELECTRON MICROSCOPY

EVER since the first Electron Microscope was constructed in 1932, it has been making a tremendous impact on various branches of science and industry. The development of Electron Microscopy in India has been more recent. However, there are today a number of institutions where facilities in this field exist. In this context, the holding of a summer school on Electron Microscopy from May 16-27, 1966 at the Central Instruments and Services Laboratory, under the auspices of the Indian Institute of Science, Bangalore, has come none too soon. The object of the school was to provide scientific investigators in research and industry with a basic knowledge of the theory and application of electron microscopy and also to present a survey of recent advances in the field.

The course consisted of 43 hours of theoretical instruction including the symposium talks, and 20 hours of practical covering the physical as well as biological sciences. Fourteen scientists constituted the teaching staff and forty-three workers attended the school.

The inauguration of the school took place on May 16, 1966. Dr. S. Dhawan, Director, Indian Institute of Science, welcomed the participants and Dr. S. R. Valluri, Director, National Aeronautical Laboratory, Bangalore, gave the address. The course commenced with a talk by Dr. (Miss) V. Kalpagam (Indian Institute of Science) on the basic ideas of the physics of the electron microscope. Dr. K. Bahadur (Defence Science Laboratory) gave four lectures which respectively were devoted to (a) diffraction theory and aberration defects in lenses which limit the resolving power of the electron microscope to about 6 to 8 Å; (b) scattering and contrast; special techniques such as shadow casting and staining employed to enhance the contrast; (c) practical factors limiting resolving power, estimation of performance, observation and recording techniques; and (d) the theory of diffraction contrast in crystalline matter and the effect of crystal imperfections.

Specimen preparation techniques in physical sciences such as replica methods, thin foil procedures, specimen supporting films and shadow casting techniques were considered by Dr. M. Ramakrishna Rao (Indian Institute of Science), Dr. V. Premanand (Atomic Energy Establishment) and Mr. S. K. Sharma (National Physical Laboratory) respectively.

Prof. M. R. A. Rao (Indian Institute of

Science), in discussing the different types of commercially available electron microscopes, drew pointed attention to some of the recent developments such as temperature control of the specimen between -150°C . and 2000°C . for the study of phase transformations and reaction kinetics.

The applications of electron microscopy in physics and metallurgy were discussed in five lectures. Dr. Bahadur dealt with the identification of imperfections in crystals, studies on evaporated films and the Moire technique which enables the resolution of lattice spacings as small as 1.5 Å. Prof. T. R. Anantharaman (Banaras Hindu University) discussed the advances made possible in the field of metallurgy by the use of the electron microscope. Typical examples of submicroscopic structural changes in eutectoidal, martensitic, precipitation and order-disorder transformations of alloys were cited.

In a symposium talk "On the recent progress in the interpretation of thin film electron micrographs", Dr. V. S. Arunachalam (Atomic Energy Establishment) pointed out various applications of the bright and dark field techniques and selected area diffraction in such diverse problems as determination of fine structure, orientation and imperfections.

Electron diffraction, a subject closely related to electron microscopy, was dealt with by Dr. R. P. Agarwala (Atomic Energy Establishment). After bringing out the salient features of the technique, he referred to some of its recent applications in the study of crystal structure, phase transformations and surface phenomena. An account of electron diffraction studies of surface films with particular reference to electrodeposition and abrasion was given by Dr. A. K. N. Reddy (Indian Institute of Science) in a symposium lecture. Two symposium talks "On the constructional details of the electron diffraction camera" and "Electron microprobe analyser" by Dr. A. Goswamy (National Chemical Laboratory) and Dr. Agarwala respectively were of topical interest in view of the urgent present-day need to fabricate scientific equipment indigenously.

Topics of considerable practical importance which were dealt with in symposium lectures were "The production and stabilization of high voltages" by Mr. P. H. Ron (Atomic Energy Establishment) and Dr. R. S. N. Rau (Indian Institute of Science) and "Recent advances in electron beam technology" by Dr. C. Amba-

sankaran (Atomic Energy Establishment). The principles of the field emission and the field ion microscopes were the subject of symposium talks by Drs. Ramakrishna Rao and Bahadur.

Dr. (Mrs.) Satyavati M. Sirsat (Indian Cancer Research Centre) started the course in biological sciences with a lecture on the ultrastructure of the cell. She also gave two symposium talks, one on "Ultrastructural aspects of the Cancer Cell" and the second on "Macromolecules".

Dr. S. R. Bawa (Punjab University) discussed the preparation of tissues and sections of biological material for electron microscopy. In a symposium lecture (illustrated by a film projection) on "Organelles of Motility" Dr. Bawa indicated the usefulness of the instrument in unravelling the intricate details of the highly specialized organelles like flagella and cilia.

Various experimental techniques like shadow casting, ultra thin sectioning and negative staining in vogue for bacteria and viruses and the preparation of macromolecules by the pseudo-replica method for electron microscopic investigations were described by Dr. S. N. Chatterjee (School of Tropical Medicine). He also delivered a lecture on the Ultrastructure of bacteria and viruses correlating structure with function. Drs. P. Sadhukhan and D. N. Misra (Saha Institute of Nuclear Physics) discussed the different procedures of "particle counting by electron microscopy and its application in quantitative virology" and "the mass thickness of biological specimens".

Mr. S. C. Mehta (Indian Agricultural Research Institute) explained the mode of handling of specimens like spores and diatoms and the purification of viruses extracted from plants for electron microscopic study.

The recent development of the thin autoradiographic emulsion with improved resolution and the application of autoradiography to electron microscopy were considered by Dr. P. N. Shrivastava (University of Rajasthan). Mr. S. D. Palekar from the same University discussed the methodology and applications of cytochemistry at the ultrastructural level.

All the participants, irrespective of their scientific background, had to undergo the practical course in the various techniques of specimen preparation in both physical and biological sciences and interpretation in the electron microscope.

The authors feel that the summer school in electron microscopy, the first of its kind in India, has more than fulfilled the object of the organisers.

Dept. of Inorganic and Physical Chemistry,
Indian Institute of Science,
Bangalore-12, H. MANOHAR.

Cytogenetics Laboratory, S. SUBRAMANYAM.
Dept. of Biochemistry,
Indian Institute of Science,
Bangalore-12,

UPWELLING IN THE MINICOY REGION OF THE ARABIAN SEA

L. V. GANGADHARA RAO AND R. JAYARAMAN

Planning and Data Division, National Institute of Oceanography, C.S.I.R., New Delhi

THE coral island, Minicoy (Latitude $8^{\circ} 7' N$, Longitude $73^{\circ} 18' E$), which is situated between the Laccadive and the Maldive Archipelagos is a major tuna-fishing centre in the Indian Ocean region.¹ While the importance of this region from the point of tuna fishery has been well recognized, we have very little data on the oceanographic conditions prevalent there. This is particularly noteworthy since in many areas, tuna investigations have always been supported by large-scale oceanographic studies.² It may also be mentioned here that one of the most important discoveries in modern oceanography, namely the Cromwell Current, is associated with the systematic investigations for

tunas in the central and equatorial Pacific by the Pacific Oceanic Fishery Investigations (POFI) group.

In one of the International Indian Ocean Expedition (IIOE) cruises in the Arabian Sea, INS KISTNA worked out a long section of 15 stations along the latitude $8^{\circ} N$ from the 27th November to the 2nd December 1962. During the occupation of stations in the vicinity of Minicoy, it was particularly noticed by one of us (R.J.) that the ship was drifting considerably giving rise to large wire angles indicating the possibility of strong water movements in the area. In addition, while examining the distribution of various parameters along this $8^{\circ} N$

section, some very interesting features were observed in respect of stations in the Minicoy region. It was, therefore, thought desirable to

make a detailed analysis of the data for various parameters in this region in particular (Stns. 84-81). The location of stations and the verti-

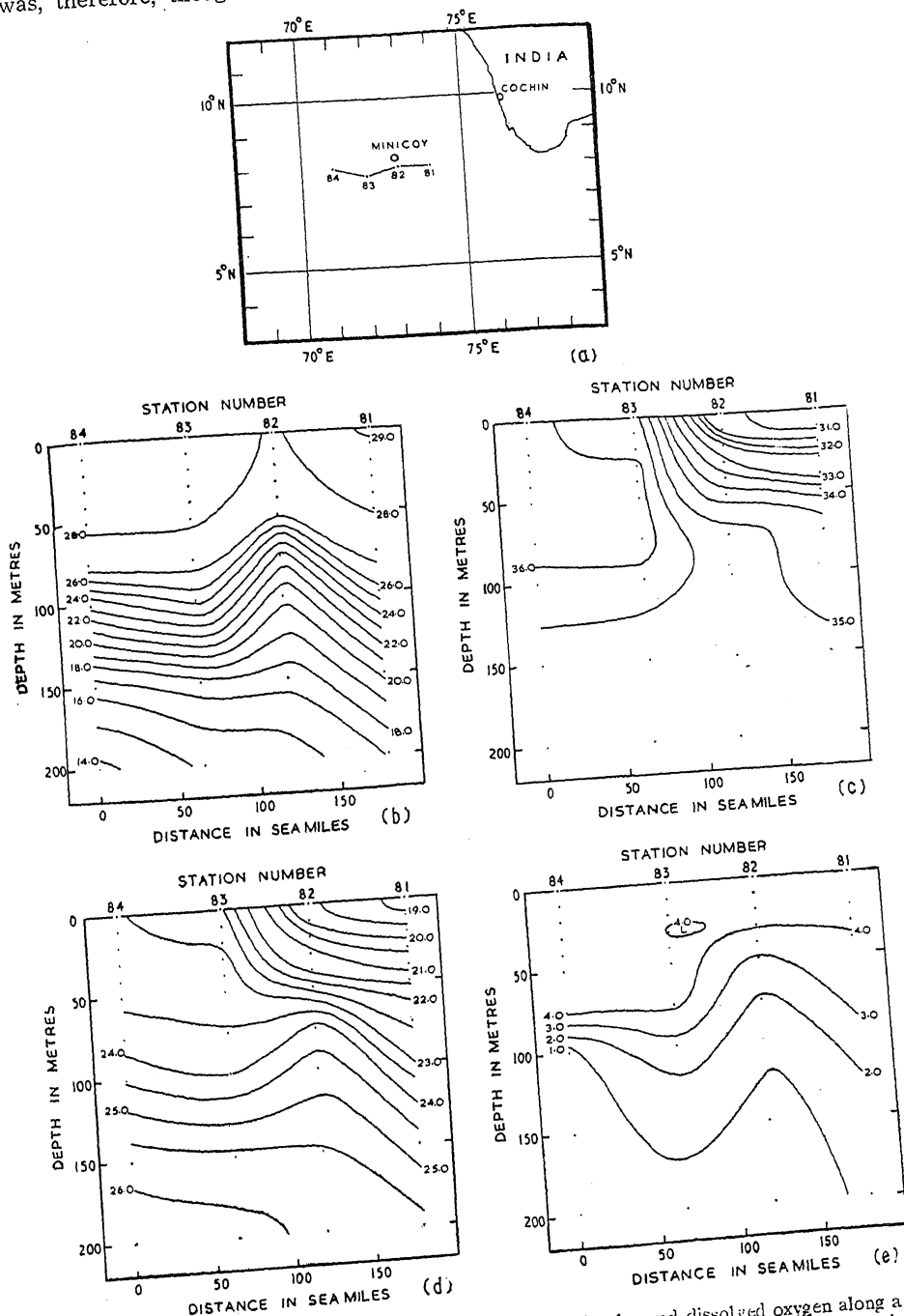


FIG. 1. Vertical distribution of temperature, salinity, density and dissolved oxygen along a section south of Minicoy Island during the last week of November, 1962. (a) Shows the location of station along the section. (b) Shows the temperature distribution-contour interval 1°C. (c) Shows the salinity distribution-contour interval 0.5‰. (d) Shows the distribution of density in terms of σ_t -contour interval 0.5 gm./litre. (e) Shows the distribution of dissolved oxygen-contour interval 1 ml./l.

cal distribution of various parameters in the upper 200 metres are shown in Fig. 1 (a-e).

At Stn. 82, the temperature structure shows a sudden decrease in the thickness of mixed layer and the presence of relatively colder water in it. In association with this feature, a sharp rise of thermocline to 50 m. depth is seen, while in the neighbouring stations it is deeper (75-100 m.). The salinity distribution shows a parcel of relatively low saline water in the surface layers at Stns. 81-82 and the resulting local halocline is seen to be surfacing at Stns. 82-83. The density structure indicates the presence of a parcel of relatively lighter water in the surface at Stns. 81-82 with its westward boundary being situated between Stns. 82-83. The isopycnals exhibit an upward tilt under Stn. 82 at 50-150 m. depth. The dissolved oxygen content is seen to be less at 40-100 m. depth under Stn. 82 compared to its value under the neighbouring stations at the corresponding depths. The distribution of all these parameters clearly indicate that upwelling is present at Stn. 82, which is situated very close to Minicoy. The phenomenon appears to be limited to the upper 150 metres.

Among the various factors examined with a view to finding out the causes of this upwelling, the most obvious seems to be the presence of diverging current systems. As the observations were taken in the last week of November, the typical circulation established for the earlier half of the north-east monsoon season (November to January)² can be taken as the representative

circulation for the period of observation. During this period, the general set of current in the southern part of the Arabian Sea is westerly. Owing to the coastal conformation, a north-north-westerly current develops off the west coast of India. These two currents diverge in the vicinity of Minicoy leading to upwelling in this region. The relatively low saline lighter water seen in the surface layers at Stns. 81-82 may be the Bay of Bengal water possibly carried westward by the north equatorial current.

It is pertinent to point out here that according to Jones and Kumaran (*loc. cit.*) in the Minicoy area, tuna fishery is operative from September to April, the peak season being from December to March. It is possible that the upwelling, which has been observed during late November, may have considerable impact on the peak tuna catches of this region. The exact sequence of events and the ultimate correlation between these physical processes and the tuna fishery of Minicoy require more detailed investigation.

The authors wish to express their deep sense of gratitude to Dr. N. K. Panikkar, Director, National Institute of Oceanography, C.S.I.R., New Delhi, for advice and encouragement.

1. Jones, S and Kumaran, M, *Indian J. Fish.*, 1959, **6** (1), 30.
2. Schaefer, M. B., *Rap Calif Ocean. Fish. Invest.*, (SS/16 b and 22 MP/4 b and 7 a), 1961, **8**, 41.
3. West Coast of India Pilot, Hydrography Dept., Admiralty, London, 1961.

NEW RECORD OF FOLIAR SCLEREIDS IN THREE DICOTYLEDONOUS GENERA

A. N. RAO

Department of Botany, University of Singapore, Singapore-10

IN order to select a few plants as experimental materials for the morphogenetic studies of foliar sclereids, the leaf anatomy of certain local dicotyledons was investigated. More than 200 species were surveyed this way, and in the lamina of certain species, the sclereids were present. A reference to the earlier literature revealed that in most of them the presence and distribution of foliar sclereids was either already recorded or described. However, in these three genera, *Agrostistachys* (Euphorbiaceae), *Taxotrophis* (Moraceae), and *Timonius* (Rubiaceae) the occurrence of foliar sclereids appears to be unrecorded so far.¹⁻³ A brief account on the cellular characters and distribution of

the foliar sclereids in these forms is presented here. The leaf clearings, sections and macerations were prepared following the procedures previously outlined by Foster.¹

Agrostistachys sessilifolia Pax and Hoffm. is an unbranched or sparingly branched shrub, common in lowland forests of Malayan Peninsula. On top of the wiry stem a tuft of elongated leaves are compactly arranged in a whorl, with humus collection in the centre, giving a characteristic appearance to the plant. An examination of cleared mature leaves shows that the sclereids are densely arranged and the fibre-like individual cells are entangled with one another (Fig. 1). Their relationship with



FIGS. 1-8. Figs. 1-3. *Agrastistachys sessilifolia*. Fig. 1. A portion of cleared lamina showing dense distribution of sclereids, $\times 158$. Fig. 2. T.S. leaf showing the sub-epidermal and obliquely oriented sclereids. The arrow points to a sclereid that connects the upper and lower epidermis, $\times 363$. Fig. 3. Paradermal section passing through palisade region with groups of sclereids, $\times 345$. Figs. 4-5. *Taxotrophis ilicifolius*. Fig. 4. A portion of cleared lamina showing the sparsely arranged sclereids, $\times 92$. Fig. 5. T.S. leaf, note the sub-epidermal position of sclereids, $\times 268$. Figs. 6-8. *Timonius wallichianus*. Fig. 6. A portion of cleared leaf showing the distribution pattern of sclereids, $\times 92$. Fig. 7. T.S. leaf showing sclereids in spongy mesophyll, $\times 200$. Fig. 8. Leaf, paradermal section showing parallel arrangement of sclereids with veins. Arrows indicate the position of sclereids, $\times 264$.

other leaf tissues was observed in transverse and paradermal sections (Figs. 2 and 3). Majority of the sclereids are sub-epidermal in position situated either between the upper epidermis and the palisade layer or the lower epidermis and the spongy mesophyll. The long axes of such sclereids are distributed parallel to the surface of the leaf. Some of the others are obliquely oriented through the mesophyll tissue, occasionally connecting the sclereids next to the upper and lower epidermis (Fig. 2). The individual sclereids are 'T', 'y' or 'L'-shaped in outline, with a thick cell wall surrounding a central lumen and on an average they are 1128μ long. Occurrence of foliar sclereids is reported in fourteen other genera of this family and *A. sessilifolia* may be included among those that have sclereids with non-stratified walls.²

Taxotrophis ilicifolius Vidal is a small tree with oblong coriaceous leaves commonly found in the coastal regions. The leaf clearings show somewhat sparsely distributed thin-walled filiform sclereids arranged in a criss-cross manner (Fig. 4). They are mainly sub-epidermal in position (Fig. 5) and the individual sclereid cell has a homogeneous wall, with prominent central lumen. Most of them are elongated (average length = 653μ) and the tips are forked to form equal or unequal branches. Mid-branching of these cells is also not uncommon displaying 't' or 'L'-shaped outline. Sclerenchymatous idioblasts in the mesophyll tissue are reported only in case of three other genera of Moraceae, but further details about their morphology and relationship with other leaf tissues are not known.²

Timonius wallichianus is a medium-sized tree very common in the secondary and primary forests of Singapore, with characteristic lanceolate silky leaves. The prominent lateral veins are somewhat parallelly arranged extending from the mid-vein to the leaf margin. The leaf clearings and paradermal sections reveal that the elongated (average length = 662μ) filiform sclereids occur either singly or in groups of 3-4 and are parallelly distributed in between

the veins (Figs. 6 and 8). Though the sclereids in this species strongly resemble the xylem fibres that accompany the tracheids, they differ and could be distinguished from them by their thicker cell walls and terminal or mid-branching. The branched sclereids are 'y', 't' or 'r'-shaped in outline. In addition, there is a second type of sclereids in the leaves of this species, which is shorter (average length = 242μ), non-branching, with a thick-pitted cell wall that surrounds a prominent central lumen. These occur as isolated structures, and occasionally in groups of two or three. As regards their positional relationship, both the types of sclereids are distributed in the spongy mesophyll tissue. The upper epidermis is covered with a thick cuticle and the cells of the lower give rise to a number of unicellular trichomes (Fig. 7).

In all the three species above described, the elongated sclereids have a smooth, non-lamellated cell wall devoid of any spicules. Only in the shorter sclereids of *Timonius* pits were discernible, and they were rarely seen on the walls of elongated sclereids in other forms. The morphology and distribution of such polymorphic filiform sclereids are reported earlier in Melastomaceae,^{5,6} Oleaceae,⁷ Loranthaceae,³ Annonaceae and Myristicaceae.⁸ To establish their exact relationship with the veinlets, further ontogenetic studies are necessary, and these are in progress. Other tropical genera of these families also need to be investigated to obtain more details about the occurrence and distribution of foliar sclereids in them and the information thus obtained may be further helpful in understanding their taxonomic relationships.

1. Sclereider H., *Systematic Anatomy of the Dicotyledons*, Clarendon Press, Oxford, 1908.
2. Metcalfe, C. R. and Chalk, L., *Anatomy of the Dicotyledons*, Clarendon Press, Oxford, 1950.
3. Rao, T. A., *J. Indian bot. Soc.*, 1951, **30**, 28.
4. Foster, A. S., *J. Arn. Arboretum*, 1955, **36**, 189.
5. — *Ibid*, 1946, **27**, 253.
6. Rao, T. A., *Phytomorphology*, 1957, **7**, 306.
7. Arzee, T., *Am. J. Bot.*, 1953, **40**, 680.
8. Rao, A. N. and Wee, Y. C. (In press).

THE SENSITIVITY OF LOW AND HIGH ALTITUDE BARLEY TO GAMMA-RAYS

B. L. KAUL

Regional Research Laboratory, Jammu-Tawi

THE factors that govern the radiosensitivity are inherent to different species of plants and other organisms. Some cellular constituents like chromosome number, nuclear volume, DNA content, chromosome structure and organisation

have a direct relationship with the radiosensitivity of the plants.^{1,2} But this sensitivity can be modified artificially by manipulating conditions before, during or after the process of irradiation. In the present note the differential

sensitivity of two types of barley is reported. One type represents a local one, which is under cultivation in North Indian plains while the second has been collected from Ladakh locally called Grim and grows at an altitude of 9-12,000 ft.

The seeds were exposed to 0, 10, 20, 30, 40 and 50 k. rads of gamma-rays. Following radiation seeds were germinated on moist filter-paper. Radiosensitivity has been measured by assaying the seedling growth and cellular abnormality. The height of the short portion was measured on 14th day. For cytological studies root-tips were fixed after 24 hours of germination in 1 : 3 acetic alcohol. Cells showing any type of chromosome aberration were scored as abnormal. The data of the seedling height are presented in Table I. Germination

TABLE I

Seedling height given as a percentage of control in grim and barley

Treatment	Seedling height % of control	
	Grim	Barley
Control	100	100
10 k. rad	96.1±2.8	95.2±1.14
20 "	58.5±2.0	70.1±1.37
30 "	48.4±1.8	63.4±1.20
40 "	41.4±1.5	49.0±1.05
50 "	32.0±1.5	45.7±0.61

in both sets started at about the same time, i.e., after 24 hours of putting them for germination. It is seen that there is a sharp reduction in seedling height in grim as compared to local barley. A 50% reduction in grim is effected by a treatment with 30 k. rads while the similar effect in local barley is given by 40 k. rad treatment. In other words there is a difference of 10 k. rad in the sensitivity of two types when seedling height reduction is taken as an index. Seedling height reduction has already been taken as a positive proof of radiation damage by many workers.³⁻⁶ The data regarding cellular abnormalities are presented in Table II

TABLE II

Comparative frequency of cells with aberrations after a treatment with gamma-rays

Treatment	% cells with aberrations in		
	Cells scored	Grim	Barley
Control	100	..	..
20 k. rad	215	19.4	12
30 "	254	33.4	22.5
40 "	197	58.4	62.4
50 "	134	69.7	65.6

where it is clear that percentage of abnormal cells for a particular dose of gamma-rays is generally higher in grim as compared to the local barley, thus supporting the data of seedling height reduction and indicating that grim is comparatively more radiosensitive than barley. Both the types, i.e., barley and grim belong to *Hordeum vulgare* with $2n = 14$. Their Karyotype is identical. The seeds were dried and stored under identical conditions and irradiation was carried out at the same dose rate and intensity, thereby eliminating all possible environmental factors that could have influenced the sensitivity of any one set of seeds.

It is well known that high altitudes differ from the plains in several ways. For instance with the increasing altitude there is a gradual decrease in temperature, pressure, oxygen tension and humidity while on the other hand there is progressive increase in the intensity and nature of ultra-violet, visible, cosmic and other radiations.⁷ In other words high altitudes receive more radiations in a certain period of time as against lower plains. According to general rules of radiobiology and natural selection it is expected that plants growing at higher altitudes should have gained some resistance to radiations. Implicitly grim that has been under cultivation at Ladakh for a very long time should have been more resistant than barley of plains. But the data presented in this do not support this contention. However, several physiological changes have already been reported to be associated with high altitudes.⁷ It is therefore presumed that some soil climatic or environmental factors have so modified the physiology of this plant that it has been rendered more sensitive to radiations.

ACKNOWLEDGMENTS

My thanks are due to Dr. E. K. Janaki Ammal for advice and encouragement and to Dr. K. Ganapathi, Director, Regional Research Laboratory, Jammu, for his interest in these studies.

1. Sparrow, A. H. and Evans, H. J., *Brookhaven Symp. in Biol.*, Brookhaven Natl. Lab. Upton, N.Y., 1961, 14, 76.
2. Evans, H. J. and Sparrow, A. H., *Ibid.*, 1961, 14, 101.
3. Caldecot, R. S., *Radiation Research*, 1955, 3, 104.
4. Ehrenberg, L., *Bot. Notiser.*, 1955, 108, 184.
5. Natarajan, A. T. and Maric, M. M., *Radiation Botany*, 1961, 1, 1.
6. Chopra, V. L., Kapoor, M. L. and Swaminathan, M. S., *Ind. J. Expt. Biol.*, 1965, 3 (2), 123.
7. Sreenivasaya, M. and Mukerji, B., "The Symposium on high altitude research," *Natl. Inst. Sci., India*, 1955, 9, 249.

LETTERS TO THE EDITOR

INTENSITY OF 1.114 Mev GAMMA
TRANSITION IN THE DECAY OF
 Zn^{65} TO Cu^{65}

IN the decay of Zn^{65} to Cu^{65} , the intensity of the gamma transition from 1.114 Mev level to the ground state of Cu^{65} has been reported to be 44 to 51%.¹⁻⁵ We evaluated the intensity of this gamma-ray by the measurement of a standard sample of Zn^{65} with our RC 650 4π gamma chamber. The chamber response was calculated at several energies in the range 0.3 to 3.0 Mev using the method given by Dale.⁶ The calculated response curve was normalized with measurements of standard samples of Co^{60} and Na^{22} . This curve was used to standardize a number of radioisotopes and the results were compared with those obtained by absolute methods. An agreement within $\pm 3\%$ was observed.⁷ This assured us of an accuracy of $\pm 3\%$ for any interpolation in this energy range for the standardization of a radioisotope if the intensities of the gammas in its decay are known. Alternatively, if the intensity of a gamma branch is not known, it can be calculated from the chamber response curve with a measurement of a standard sample of the radioisotope. However, this is possible only in the case of a simple decay scheme with a single gamma branch.

A sample of Zn^{65} obtained from International Atomic Energy Agency was measured on the ionization chamber. The activity of the sample was given as $(98.4 \pm 2 \mu c)$ on the reference date. The ionization current duly corrected for the decay of the sample from the reference date was found to be $(2.33_3 \pm 0.01)$ pA. The ionization current is due to the contribution of the annihilation quanta of β^+ and 1.114 Mev gammas. The contribution due to X-rays from EC and internal conversion of 1.114 Mev level is negligible as the X-rays are stopped by the 1 gm./cm.² thick wall of the chamber. The contribution to ionization from annihilation quanta of β^+ (1.4 ± 0.04) %⁵ in intensity was calculated to be $(0.06_5 \pm 0.01)$ pA. This was subtracted from the total ionization current to get the contribution due to gammas only, which came out to be $(2.26_8 \pm 0.01)$ pA. This corresponds to $(186.7 \pm 2) \times 10^4$ gammas per second of 1.114 Mev energy when referred to the chamber response curve. Thus we get a value of $(51.3 \pm 1.5)\%$ for the intensity

of 1.114 Mev gamma transition in the decay of Zn^{65} to Cu^{65} . This value is in good agreement with the value recently reported.⁵

The author wishes to thank Dr. U. C. Gupta for his suggestions and encouragement and Shri G. H. Vaze for his keen interest in the work.

Nuclear Instruments and P. S. RAO.

Systems Section, Electronics Division,
Atomic Energy Establishment,
Trombay, Bombay, May 12, 1966.

1. Good, W. M. and Peacock, W. C., *Phys. Rev.*, 1946, **69**, 680 a.
2. Perkins, J. F. and Haynes, S. K., *Ibid.*, 1953, **92**, 687.
3. Sehr, R., *Z. Physik*, 1954, **137**, 523.
4. Gleason, G. I., *Phys. Rev.*, 1959, **113**, 287.
5. Taylor J. G. V. and Merritt, J. S., *Physics in Canada*, 1963, **19** (3), 17.
6. Dale, J. W. G., *Int. J. of Appl. Rad. Isotopes*, 1961, **10**, 72.
7. Rao, P. S. and Gupta U. C., *Characteristics of RC 650 4π Gamma Ionization Chamber*. (Unpublished).

LIFETIMES OF 1554 AND 1289 KeV
LEVELS OF W^{182}

THE level scheme of W^{182} was studied by Murray *et al.*¹ and is interpreted as involving, primarily, states associated with four rotational bands. The measurements of the lifetimes of the different excited states of W^{182} are made with a delayed coincidence spectrometer. The results of the 1554 and 1289 KeV levels are only given here and those of the remaining levels were described elsewhere.²

The associated circuitry of the present equipment is almost similar to the one described by Green and Bell.³ Plastic scintillators are employed for the detection of conversion electrons and beta-rays. The arrangement is set in such a manner that the logarithmic slope of the delayed time distribution in positive time represents the lifetime of the level under consideration. The time spectra are recorded on a 10-channel pulse height analyser. The resolving time of the instrument observed is 0.78 ns. for Co^{60} and slopes correspond to half-lives of 8.12×10^{-11} sec.

The isotope Ta-182 is supplied as slurry of Tantalum pentoxide in dilute potassium hydroxide solution with an activity of 3.3 mc. in 2.5 ml. The lifetime of the 1554 KeV level is determined by observing coincidences between the beta-

rays feeding the level and one of the five gamma components (264) de-exciting from this level. Gamma-rays are detected in NaI(Tl) crystal so as to avoid any ambiguity in selection. The time spectrum is recorded and is shown in Fig. 1. The lifetime of the 1289 KeV level is

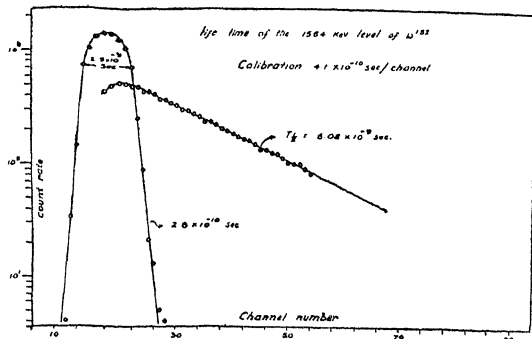


FIG. 1

determined by observing coincidences between the 264 KeV gamma-rays and 67.7 KeV gamma-rays. Though there are two more gamma components feeding this level the selection of 264 KeV component is free from the influence due to the lifetimes of other levels. These two gamma-rays 264 and 67.7 KeV are detected in NaI(Tl) crystals. The time spectrum is recorded and is shown in Fig. 2. In both Figs. 1 and 2 the prompt resolution curve recorded with Co^{60} in the two arrangements are shown for comparison. The lifetimes are determined from the slopes of the time distributions. A least square fit analysis of the data is carried out to determine the lifetimes. The average values of the lifetimes of the 1554 and 1289 KeV levels obtained from three sets of experiments are 5.07 ± 0.16 ns. and 1.08 ± 0.04 ns. These values include an error of 3% arising out of the calibration and measurement of cable lengths. The present values of the lifetimes are in good agreement with the previous results, namely 4.7 ± 0.3 ns. and 1.04 ± 0.03 ns., reported by Bashandy *et al.*⁴

The transitions 67.7 and 222 KeV were identified as pure E1 transitions. The partial lifetimes of these transitions are calculated from the presently measured values of the lifetimes of the 1289 and 1554 KeV levels respectively. The experimental half-lives are corrected for internal conversion, branching and mixing ratios which were taken from the work of Murray *et al.*¹ The experimental transition probabilities calculated are compared with the single particle estimates. It is observed that these two transitions are retarded by large

magnitudes and the retardation factors for the 67.7 and 222 KeV transitions respectively are 3.37×10^3 and 9.21×10^3 .

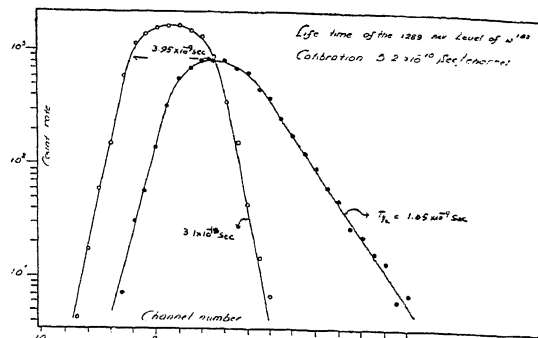


FIG. 2

One of the authors (B. V. N. R.) wishes to express his grateful thanks to Dr. V. Lakshminarayana for useful discussions, and to the Council of Scientific and Industrial Research, for a Research Fellowship.

The Laboratories for B. V. NARASIMHA RAO.
Nuclear Research, SWAMI JNANANANDA,
Andhra University,
Waltair, February 28, 1966.

1. Murray, J. J., Bohenv, F., Marmier, P. and Dumond, J. W., *Phys. Rev.*, 1955, **97**, 1007.
2. Narasimha Rao, B. V., *Ph.D. Thesis*, Andhra University, Waltair.
3. Green, R. E. and Bell, R. E., *Nucl. Inst.*, 1958, **3**, 127.
4. Bashandy, E., El Nesr, M. S. and Pancholi, S., *Nucl. Phys.*, 1963, **41**, 346.

CHEMICAL SHIFTS OF Co^{59} IN SOME AQUO-COBALTIC COMPLEXES

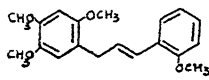
THE nuclear magnetic resonance of Co^{59} has been observed in a number of trivalent cobalt complexes by earlier workers.¹⁻³ Biradar and Kanekar⁴ established an order of increasing ligand field strength for series of ligands from the observed NMR data in several pentammine cobalt (III) complexes. These data are, in general, in conformity with spectrochemical series for ligand fields.

The NMR measurements were made on Varian wide line Spectrometer V4200 at about 10,000 gauss. The shift measurements were made in aqueous solutions. The values have been expressed as dimensionless quantity σ % defined as

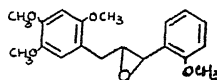
$$\frac{H_{\text{sample}} - H_{\text{standard}}}{H_{\text{standard}}} \times 100$$

where H_{sample} is the resonance field for complex and H_{standard} for the field of the reference

of epoxy group. That the compound is 2:4:5-trimethoxybenzyl-2'-methoxy styrene epoxide (II) was shown by deoxygenation with triphenyl phosphine at 200° for 10 mt. to the corresponding benzyl styrene identical on T.L.C. with an authentic sample.



I



II

Clearly the epoxide is formed from the benzyl styrene during its passage through the column. The oxidising agent should be silver oxide formed on the column by interaction with alumina but the latter has also a role to play as simple silver oxide is not effective. The alternative possibility is aerial oxidation catalysed by Ag^+ ions under the basic conditions of the column. In view of the wide use of silver nitrate column there is need to be cautious about this side reaction.

Department of Chemistry, DARSHAN KUMARI.
University of Delhi, S. K. MUKERJEE.
Delhi-7, May 2, 1966. T. R. SESHADRI.

1. Dutton, H. J., Schofield, C. R. and Jones, E. P., *Chem. and Ind.*, 1961, p. 1874.
2. Gilav, E., Herting, J. and Shablat, J., *J. Chromatog.*, 1958, **1**, 508.
3. Goering, H. L. and Olson, A. C., *J. Amer. Chem. Soc.*, 1961, **83**, 3507.
4. De Vries, B., *Chem. and Ind.*, 1962, p. 1049.
5. —, *J. Amer. Oil Chemists Soc.*, 1963, **40**, 184.
6. Morris, L. J., *Chem. and Ind.*, 1962, p. 1238.
7. Barrett, C. B., Dallas, M. S. and Padley, F. B., *J. Amer. Oil Chemists Soc.*, 1963, **40**, 580.
8. Gunstone, F. D. and Sealy, A. J., *J. Chem. Soc.*, 1963, p. 5779; 1965, p. 322.
9. De Jong, K., Mostert, K. and Slood, D. *Re. Trav. Chim.*, 1963, **82**, 837.
10. Kumari, D., Mukerjee, S. K. and Seshadri, T. R., *Curr. Sci.*, 1965, **35** (24), 690.

THORIUM-MELANOXETIN COMPLEX, A SPECTROPHOTOMETRIC STUDY

It is established¹ that flavonoids containing 3-hydroxy or 5-hydroxy group or both combine with thorium ions in equimolar ratio to form yellow-coloured complexes. In the present communication the complex formation between thorium and melanoxetin (7, 8, 3', 4'-tetrahydroxy flavanol) has been described. The ligand has been earlier used in spectrophotometric determination of zirconium.²

Melanoxetin was isolated from the ether extract of the heartwood of *Albizia lebeckii*.³ Its standard solution was prepared in alcohol. Thorium nitrate (A.R., B.D.H.) was used for preparing standard solutions after standardising

by oxine method. Absorbance readings were taken with a Unicam SP-600 spectrophotometer and for pH measurements a metrohm pH-meter type E-350 was used.

The reagent has been found to exhibit λ_{max} at 254 and 310 $\text{m}\mu$. Solutions were prepared containing thorium and the ligand in different molar ratios (1.0:0.33 to 1:10) and at different pH's (1.5 to 4.0). They were diluted to 10.0 or 12.5 ml. maintaining 40% alcoholic medium to avoid possible precipitation of the reagent. Absorption spectra of the solutions taken against corresponding reagent blanks show λ_{max} at 420 $\text{m}\mu$ (Fig. 1) in all cases. Also, absorption

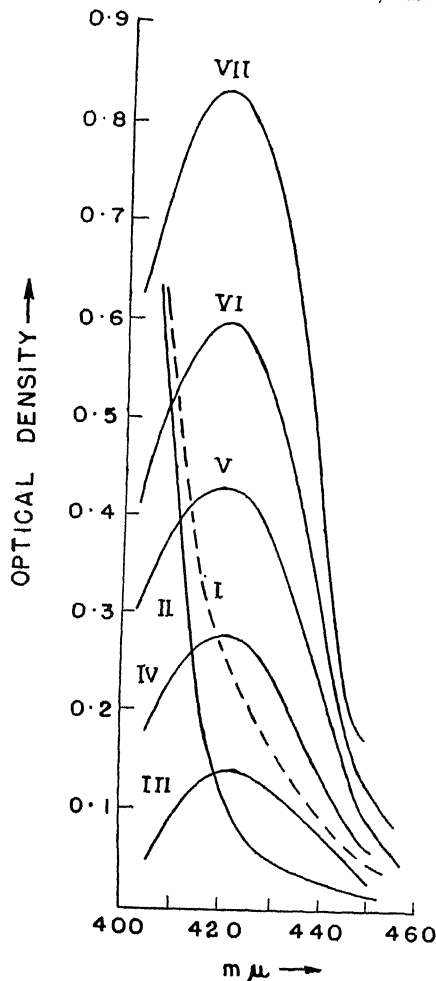


FIG. 1. Absorption spectra. I 0.4 ml. Th (M/2500) + 4.0 ml. R (M/2500); pH 2.0; TV 10.0 ml. II 4.0 ml. R (M/2500); pH 2.0; TV 10.0 ml. III 1.1 ml. IV. 0.4 ml. Th (M/2500) + 4.0 ml. R (M/2500); pH 3.0; TV 10.0 Reagent blank. V. 1.5 ml. Th (M/2500) + 1.0 ml. R (M/2500); pH 2.0; TV 12.5 ml.; Reagent blank. VI. 1.5 ml. Th (M/2500) + 1.5 ml.; R (M/2500); pH 2.0; TV 12.5 ml. Reagent blank. VII. 1.5 ml. Th (M/2500) + 2.0 ml. R (M/2500); pH 2.0; TV 12.5 ml.; Reagent blank.

due to the reagent is significant at 420 m μ and therefore it was used as blank in subsequent studies.

Between pH 1.5 and 2.5 there is hardly any change in absorption of the reagent. Above pH 2.5 there is, however, gradual rise in its colour intensity. Optical density of the complex increases from pH 1.5 to 3.0. Between pH 3.0 and 3.5 it markedly decreases while it remains practically constant between pH 3.5 and 4.0. But in this latter range of pH there is significant increase in optical density of the reagent and also possibility of hydrolysis of thorium ions may not be ignored. For subsequent studies pH 2.0 was selected because optical density of the reagent remains constant within the change of ± 0.5 pH. Also there is no danger of thorium ions getting precipitated.

The complex has been found to obey Beer's law from 0 to 7 ppm of thorium at pH 2.0. Sensitivity of the reaction has been found to be $0.011 \gamma \text{ Th/cm.}^2 \equiv \log I_0/I = 0.001$. Average value of stability constant of the complex has been calculated to be 4.8×10^3 at pH 2.0 and in 40% alcoholic medium (20°C.). The molar composition of the complex has been ascertained by the methods of mole ratio, slope ratio and continuous variations (Fig. 2). The formation of a 1:1 complex is concluded.

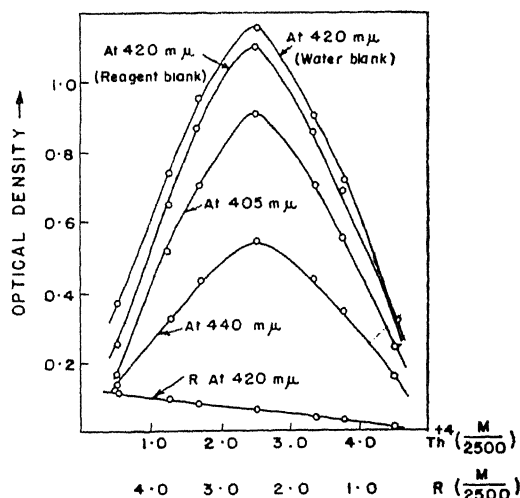


FIG. 2. Determination of composition of the complex by the method of continuous variations.

The ligand, though quite sensitive for thorium, cannot be used for its determination because of the interferences caused by most of the ions. A prior separation of the accompanying ions is essential. The work in this respect is in progress.

Department of Chemistry,
University of Delhi,
Delhi-7, March 21, 1966.

M. KATYAL.
S. PRAKASH.
R. P. SINGH.
K. K. MALIK.

1. Katyal, M., *Ph.D. Thesis*, Delhi University, 1965.
2. —, Gupta, B. P. and Singh, R. P., *Curr. Sci.*, 1965, **34**, 456.
3. Gupta, S. R., Malik, K. K. and Seshadri, T. R., *Ind. Jour. Chem.*, 1966, **4**, 139.

RARE-EARTH PERCHLORATE ADDUCTS WITH DIMETHYL FORMAMIDE

In continuation of our studies on rare-earth nitrate complexes with dimethyl formamide (DMF)¹ we report here the isolation and characterization of six new complexes of rare-earth perchlorates with DMF.

The complexes were prepared by dissolving the hydrated rare-earth perchlorates in DMF and pumping off the excess solvent (avoiding contamination with moisture), when the complexes were left behind as glistening hygroscopic crystals. Analyses of metal, perchlorate and DMF contents of the complexes conform to the formula $M(\text{DMF})_x (\text{ClO}_4)_3$ where $M = \text{La, Ce, Pr, Nd, Sm or Y}$. The complexes are soluble in polar solvents such as acetone, nitromethane, nitrobenzene, etc., and insoluble in non-polar solvents like benzene or heptane.

Conductivities of the complexes in nitromethane lie in the range $210\text{--}220 \Omega^{-1} \text{ cm.}^2 \text{ mole}^{-1}$, showing that the complexes behave as 1:3 electrolytes in this solvent. The infra-red spectra of the complexes recorded in KCl pellet are all similar showing no significant dependence on the nature of the metal. Taking the cerium complex as a typical example, the lowering of the $\text{C}=\text{O}$ stretching frequency (1650 cm.^{-1}) compared with ligand (1680 cm.^{-1}) suggests that the amide co-ordinates to the metal through oxygen.² Accordingly the $\nu_{\text{C-N}}$ vibration (1094 cm.^{-1}) and $\text{N}-\text{C}=\text{O}$ bending vibration (658 cm.^{-1}) are shifted to higher values in the complexes, 1124 and 675 cm.^{-1} respectively. The bands at 1090 and 625 cm.^{-1} are assigned to ν_3 and ν_4 vibrations of ionic perchlorate, the observed splitting of the bands being attributed to interactions discussed by Ross.³ It thus appears that the co-ordination number of the rare-earths in these complexes is eight. Eight co-ordination for rare-earths is not uncommon.⁴

The authors thank Prof. M. R. A. Rao for his keen interest in this work. One of them (S. S. K.) thanks the U.G.C. for a Fellowship.

Dept. of Inorganic and Physical Chemistry,
Indian Institute of Science,
Bangalore-12, May 31, 1966.

S. S. KRISHNAMURTHY.
S. SOUNDARARAJAN.

1. Krishnamurthy, S. S. and Soundararajan, S., *J. Inorg. Nucl. Chem.*, 1966 (In Press).
2. Bull, W. E., Madam, S. K. and Willis, J. E., *Inorg. Chem.*, 1963 **2**, 303.
3. Koss, S. D., *Spectrochim. Acta*, 1962, **18**, 225.
4. Moeller, T. *et al.*, *Chem. Reviews*, 1965, **65**, 1.

CHEMICAL INVESTIGATION OF THE BARK OF RHODODENDRON ARBOREUM Sm.

PLANTS belonging to the genus *Rhododendron* are considered to be poisonous to cattle. *Rhododendron arboreum* Sm. (syn., *R. Nilagiri-cum* Zenk), is a small tree with beautiful flowers growing at altitudes of about 5000 ft. The leaves and flowers collected in the Nilgiri Hills were examined by Rangaswami and Sambamurthy.^{1,2} The results of the chemical examination of the bark are described here.

One sample of the bark collected in Darjeeling hills gave in the petroleum ether extract a single triterpenoid substance in 0.05% yield having the following properties: colourless needles, m.p. 280–82°; $[\alpha]_D \pm 0^\circ$, formula $C_{30}H_{50}O$; acetate $C_{32}H_{52}O_2$, m.p. 306–08°, $[\alpha]_D + 19.3^\circ$; benzoate, m.p. 294–95°, $[\alpha]_D + 45.8^\circ$. These indicated its probable identity as taraxerol. It was confirmed by the preparation of taraxerone, $C_{30}H_{48}O$, m.p. 239–40° following the procedure of Koller *et al.*³

Another sample of the bark collected from Simla hills gave from the petroleum-ether extract a mixture in which only a minute amount of taraxerol was present, and it was identified by TLC. For separating the mixture, the total petroleum-ether extract was partitioned between aqueous sodium hydroxide and ether. The ether extract gave on evaporation a solid which on chromatography over neutral alumina gave colourless needles, m.p. 294–96°, $[\alpha]_D + 64^\circ$, formula $C_{32}H_{50}O_4$. It reacted with diazomethane giving a methyl ester $C_{33}H_{52}O_4$, m.p. 243–45°, $[\alpha]_D + 75.4^\circ$. These two substances proved to be identical with ursolic acid acetate and methyl acetyl ursolate by comparing with the respective authentic samples available in our collection (mixed m.p. and superimposable I.R. spectra). The identity of the parent compound as ursolic acid acetate was confirmed by saponifying with 2N methanolic potash. The acid that was precipitated on removing the methanol and acidifying was identical with

ursolic acid (m.p. and mixed m.p. 285–87°). The acidic aqueous filtrate was distilled. The initial portion of the distillate gave a strong positive reaction for acetic acid in the lanthanum nitrate test.

The alkaline solution from which ursolic acid acetate had been removed, as described earlier, was acidified and the precipitated solid was converted into the methyl ester and chromatographed over alumina for purification. The principal substance obtained from the chromatogram was identical with betulinic acid methyl ester which is described in greater detail under the ether extract.

The ether extract of the bark following petroleum-ether extract gave a copious amount of a triterpenoid acid; feathery needles from methanol, m.p. 309–10°, $[\alpha]_D + 18.6^\circ$ (pyridine), formula $C_{30}H_{48}O_3$; acetate $C_{32}H_{50}O_4$, m.p. 288–99°, $[\alpha]_D + 29.2^\circ$; methyl ester $C_{31}H_{50}O_3$, m.p. 223–25°, $[\alpha]_D + 8.9^\circ$; methyl ester acetate m.p. 198–99°, $[\alpha]_D + 13.1^\circ$; methyl ester benzoate, m.p. 250–52°, $[\alpha]_D + 31.3^\circ$. These properties and colour reactions and the evidence for the presence of the group $>C=CH_2$ (absorption at 885 cm^{-1} in the I.R. spectrum) led to the possible identity of the acid as betulinic acid. For confirmation the methyl ester was subjected to ozonolysis. As the volatile product formaldehyde was identified as the dimeric derivative, m.p. 182° and the non-volatile product as betulinic methyl ester nor-ketone, m.p. 147–49°. The methyl ester of the parent acid was further subjected to reduction with lithium aluminium hydride to get the corresponding alcohol betulin, m.p. 256–58°.

The acetone extract of the bark after ether extraction was concentrated, the residue taken in ethyl acetate and the ethyl acetate concentrate diluted with petroleum ether. The precipitated solid after repeated purification through ethyl acetate and petroleum ether gave reactions for leucoanthocyanidins. After conversion into flavylum salt by boiling with alcoholic hydrochloric acid, the flavylum salt solution was examined by paper chromatography. There were three spots, of which the principal one was separated in sufficient quantity by preparative paper chromatography. Examination by standard colour reactions showed that it was pelargonidin chloride; it had an absorption maximum at 530 $m\mu$ which was not affected by the addition of aluminium chloride. The substance from the acetone extract is therefore mainly leucopelargonidin.

Taraxerol has not so far been reported from any *Rhododendron* species. To our knowledge

there is only one recorded instance of the natural occurrence of ursolic acid acetate and this is in the bark of a New Zealand plant *Leptospermum scoparium*⁴ (Fam: Myrtaceae). The high yield of betulic acid (4%) is noteworthy.

The authors thank Prof. T. R. Seshadri for his kind interest.

All the rotations were taken in chloroform except where otherwise stated.

Department of Chemistry, V. HARIHARAN.
University of Delhi, S. RANGASWAMI.
Delhi-7 May 11, 1966.

1. Rangaswami, S. and Sambamurthy, K., *Proc. Ind. Acad. Sci.*, 1959 **50A**, 366.
2. — and —, *Ibid.*, 1960, **51A**, 322.
3. Koller, E., Hiestand, A., Dietrich, P. and Jeger, O., *Helv. Chim. Acta*, 1950, **33**, 1051.
4. Corbett, R. E. and McDowall, M. A., *J. Chem. Soc.*, 1958, p. 3715.

PENTAERYTHRITOL ACETATES

PENTAERYTHRITOL under different experimental conditions forms mono-, di-, tri- and tetra-acetates when treated with glacial acetic acid or acetic anhydride. The preparation of mono-, di- and tri-acetates of pentaerythritol has not attracted much attention as compared with tetra-acetate. Orthner and Freyss¹ have prepared the di-acetate by acetylating pentaerythritol mono-acetonal followed by the hydrolysis of the ketal group. Barth *et al.*² employed the alcoholysis of pentaerythritol tetra-acetate in presence of an alkaline catalyst for the preparation of di-, and tri-acetates of pentaerythritol. Marans³ and co-workers have made use of the above method for the preparation of mono-acetate. During the course of our investigation we have developed simple methods for the preparation of each of these individual esters in good yield.

1. *Pentaerythritol Tri-acetate*.—Pentaerythritol (68 gm., 0.5 moles), glacial acetic acid (240 gm., 4 moles) and toluene (250 c.c) were taken in a Dean & Stark's apparatus. The mixture was refluxed for about 10 hours on an oil-bath maintained at 140–150° C. During this time most of the water was removed from the reaction mixture by the side arm of the apparatus. The refluxing was discontinued when the distillate collecting in the side arm contained no more water. The toluene was removed by vacuum distillation. The crude ester was then extracted with hot acetone and filtered. The filtrate on removal of acetone was fractionated under vacuum. The fraction dis-

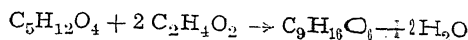
tilling at 175–180° C./2 mm. was collected to give pentaerythritol tri-acetate. The overall yield was 85%. The degree of esterification was confirmed by acetyl group estimation, formation of a nitrate ester and carbon hydrogen analysis.

Analysis calculated for $C_{11}H_{18}O_7$: C, 50.38; H, 6.87.

Found: C, 50.47; H, 6.68.

Under usual conditions of esterification using acetic acid, the esterification has been found to proceed and stop at the triester stage.

2. *Pentaerythritol Di- and Mono-acetate*.—Pentaerythritol (68 gm.; 0.5 moles), glacial acetic acid (60 gm.; 1 mole), dimethyl formamide (250 c.c.) and toluene (150 c.c.) were taken in Dean and Stark's apparatus. The mixture was refluxed for about 7 hours on an oil-bath maintained at 150–160° C. After the theoretical amount of water as indicated by the equation was collected,



in the side arm of the apparatus, the mixture was cooled and solvents were removed in vacuum. The residue consisting of mono- and di-acetate of pentaerythritol was extracted with hot acetone and filtered. The filtrates were combined and the acetone was distilled off to leave behind the crude acetates. The mixture was finally fractionated and fractions distilling at 200–205° C./1 mm. (pentaerythritol di-acetate, and at 215–220° C./1 mm. (pentaerythritol mono-acetate) were separately collected. The overall yield of pentaerythritol di-acetate was 30% and that of mono-acetate was 20%. The m.p. of mono-acetate was 65° C. The constitutions were confirmed by acetyl group estimation formation of nitrate ester and carbon, hydrogen analysis.

Analysis Calculated for $C_7H_{14}O_5$: C, 47.19; H, 7.87.

Found: C, 47.22; H, 7.98.

Calculated for $C_9H_{16}O_6$: C, 49.09; H, 7.27.

Found: C, 49.15; H, 7.20.

3. *Pentaerythritol Di-acetate*.—Pentaerythritol (68 gm., 0.5 moles), pentaerythritol tri-acetate (65.5 gm., 0.25 moles) was heated in presence of 1.5 gm. of potassium carbonate for 6 to 7 hr. at 180–185° C. The reaction mixture was distilled under vacuum at 170–210° C./1 mm. to give a mixture of products. The distillate was extracted with hot acetone and filtered. After removing acetone the crude pentaerythritol di-acetate was fractionated under vacuum and fraction distilling at 208–215° C./2 mm. was

collected. The overall yield of pentaerythritol di-acetate was 72%.

Explosives Research and KUNWAR BAHADUR.
Development Laboratory, W. D. PATWARDHAN.
Kirkee. Poona-3. February 15, 1966.

1. Ortner, I. and Freyss, G., *Ann.*, 1930, **484**, 131.
2. Barin, R. H. and Burrell, H., U. S. Patent 2356745 (August 29, 1944).
3. Marans, N. S., Elrick, D. E. and Preckel, R. F., *J. Amer. Chem. Soc.*, 1954, **76**, 1304.

ON THE REACTION OF AMINO-ACIDS AND TEA QUINONES

MAYURANATHAN and GOPALAN¹ have recently reported results of an investigation in which they claim to show that tea quinones do not cause an oxidative deamination of amino-acids as had been proposed by Bokuchava and Popov.^{2,3} However, it appears as though Mayuranathan and Gopalan¹ have mistakenly used products of the oxidation of tea flavanols which are not quinones and this has led to the drawing of erroneous conclusions. Inasmuch as the interaction of oxidized tea flavanols (tea quinones) and amino-acids may be very important in determining the organoleptic characteristics of black tea,²⁻⁸ it is important to try to clarify this matter.

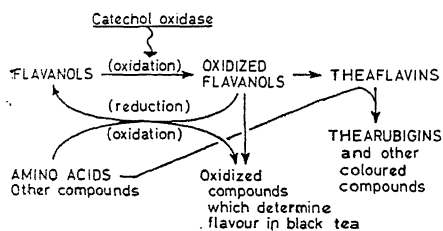


FIG. 1. A proposed scheme for tea fermentation¹¹ showing the relationship between the catechol oxidase catalyzed oxidation of tea flavanols and the oxidation of amino-acids and other compounds found in tea tissues.

The mechanism for the oxidative deamination of amino-acids during fermentation in the manufacture of black tea which was proposed by Bokuchava and Popov^{2,3} very clearly requires the presence of orthoquinones which are produced by the action of catechol oxidase on tea flavanols during this process.^{9,10} The orthoquinones so formed would be expected to have a very short life because of the great reactivity of such compounds and, therefore, it would be expected that any reactions brought about by these orthoquinones would have to take place within seconds of the time that the orthoquinones

were formed. If the orthoquinones are not reduced back to their original state in the process of causing an oxidation of amino-acids (or other compounds present in tea), they condense to form brown-coloured substances such as theaflavins and thearubigins.^{9,10} These reactions are shown in Fig. 1 and they are discussed in more detail elsewhere.¹¹ Since it is unlikely that enzymes capable of bringing about the oxidative deamination of amino-acids are present in fermenting tea material¹² it is important to notice that the only agents required for this reaction are an active catechol oxidase and flavanols; both of which are present in large amounts in tea shoot-tips. Bhatia and Deb⁷ have failed to take these points into consideration in their recent criticism of Popov's^{2,3} scheme for the oxidative deamination of amino-acids during tea fermentation.

The ability of oxidized flavanols to catalyze the oxidation of amino-acids has been shown by several investigators^{2-5,13} and there is little reason to doubt that they occur during fermentation in black tea manufacture.¹¹ The inability of Mayuranathan and Gopalan¹ to demonstrate an oxidation of amino-acids is simply explained by the fact that they were not using 'tea quinones' as they claimed, but rather they were extracting and using the coloured products of tea fermentation which are found in made tea and which are quite unreactive.

Tea Research Institute G. W. SANDERSON.
of Ceylon,
Talawakelle, Ceylon, March 17, 1966.

1. Mayuranathan, P. S. and Gopalan, K. K., *J. Ed. Sci. Technol.*, 1965, **2**, 1.
2. Bokuchava, M. A. and Popov, V. R., *Doklady Akad. Nauk., S.S.S.R.*, 1954, **99**, 145.
3. Popov, V. R., *Biochimiya*, 1956, **21**, 380.
4. Nakabayashi, T., *Nippon Nogei-Kagaku Kaishi*, 1958, **32**, 757; (*Chem. Abs.*, 1959, **53**, 6478d).
5. Wickremasinghe, R. L. and Swain, T., *Chem. and Ind.*, 1961, p. 1574.
6. — and —, *J. Sci. Ed. Agric.*, 1965, **16**, 57.
7. Bhatia, I. S. and Deb, S. B., *Ibid.*, 1965, **16**, 759.
8. Roberts, G. R. and Sanderson, G. W., *Ibid.*, 1966, **17** (In press).
9. Roberts, E. A. H., *Ibid.*, 1958, **9**, 381.
10. —, in *The Chemistry of Flavonoid Compounds*, Editor, Geissman, T. A., Pergamon Press Ltd., London, 1962, p. 468.
11. Sanderson, G. W., *Tea Quart.*, 1965, **36**, 172.
12. —, *Biochem. J.*, 1965, **95**, 24.
13. Trautner, E. M. and Roberts, E. A. H., *Austra. J. Sci. Research*, 1950, **3B**, 356.

OCCURRENCE OF DORSAL ORGAN IN *CINGALOBOLUS BUGNIONI*, A DIPLOPOD

OCCURRENCE of dorsal organ in the early embryonic stages is a common feature among arthropods.^{1,2} But workers on diplopods did not find a dorsal organ in the forms studied by them.¹ However, Tiegs³ suggested, 'a more extensive search amongst the diplopods might, nevertheless, reveal its presence in some forms'. It is therefore of interest that in the course of our study on the embryology of *Cingalobolus bugnioni* we have noted the presence of a well-developed dorsal organ in the early embryos of this diplopod.

Females of *Cingalobolus bugnioni* laid eggs readily in captivity, so that eggs of known age were obtained and fixed in aqueous Bouin. Sections were prepared by double embedding in celloidin and wax and stained in Heidenhain's hæmatoxylin.

Examination of sections of embryos of various stages of development shows that there is present in the 6 to 7 days old embryos, at a mid-dorsal position between the cephalic and caudal ends of the germ band, a disc of 25 to 30 cells, distinguishable from the contiguous blastoderms in their large size and heavily granular cytoplasm (Fig. 1). The cells of the

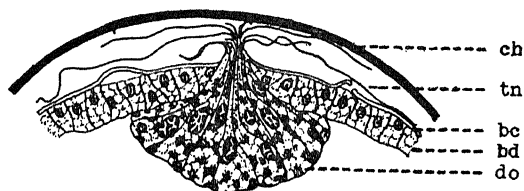


FIG. 1. T.S. of a 7 days old embryo of *Cingalobolus bugnioni* through the dorsal organ, $\times 180$. (Stained in Heidenhain's hæmatoxylin) *bc*: blastodermic cuticle; *bd*: blastoderm; *ch*: chorion; *do*: dorsal organ; *tn*: tendril.

disc have their long axes towards the middle of the embryo. The external surface of these cells is much reduced that they form a narrow neck which protrudes as a small conical papilla on the surface of the blastoderm. Through this neck, each cell of the disc retains its association with the surface. A feature of interest is the presence of tendril-like extra embryonic outgrowths, from the external surface of the cells of the disc, which run into the space between the chorion and the blastodermic cuticle. Embryos dissected out of the chorion, and some of the embryonic material gently squeezed out through an incision at the ventral surface, disclose the tendrils spreading out all over the surface of the blastodermic cuticle, forming a

mesh and swathing the embryo as in a crate (Fig. 2).

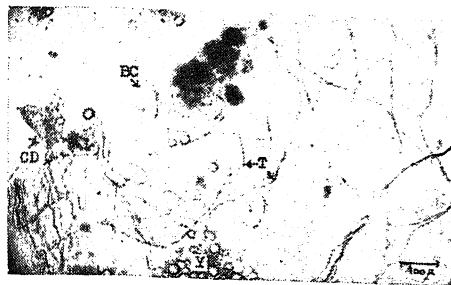


FIG. 2. Unstained whole mount of a 7 days old embryo of *Cingalobolus bugnioni*, *BC*: Blastodermic cuticle; *CD*: Two cells of the dorsal organ; *T*: Tendrils; *V*: Yolk bodies.

The features delineated above of the embryonic structure in *Cingalobolus bugnioni* recalls remarkably those of the dorsal organ of symphylid *Hanseniella agilis*.⁶ It may be noted in this context that, based on some features of development, Tiegs⁶ has suggested a close phylogenetic relationship between Diplopoda and Symphyla. The presence of a symphylid-type of dorsal organ in a diplopod, *Cingalobolus bugnioni*, would substantiate Tiegs.

I am greatly indebted to Dr. A. Chidambaram Nathan Chettiar, Principal, for his interest in this investigation.

Department of Zoology, G. SUNDARA RAJULU.
Thiagarajar College,
Madurai-9, February 10, 1966.

1. Sedgewick, A., *Quart. J. Micr. Sci.*, 1885, **25**, 304.
2. Manton, S. M., *Phil. Trans. Roy. Soc. (Lond.)*, 1928, **216B**, 363.
3. Heymons, R. I., *Zoologica* 1901, **33**, 61.
4. Verhoeff, K. W., *Diplopoda*. In *Bronn's Klassen und Ordnungen des Tierreichs*, Vol. 5, abt. 2, Buch 3.
5. Tiegs, O. W., *Quart. J. Micr. Sci.*, 1944, **84**, 35.
6. —, *Ibid.*, 1940, **325**, 1.

SCLEROTIUM WILT OF JASMINE IN MYSORE

SCLEROTIUM wilt has a very wide distribution throughout the tropics and warmer parts of the temperate zones, and is perhaps one of the most common and destructive diseases of plants. Study of literature on this fungus shows report of nearly 200 hosts distributed amongst 50 families of flowering plants. This list was compiled in 1931 and since then many new hosts have been added.

The first record of Sclerotium wilt was by Rolfs from Florida in 1893. In 1911 Saccardo named this wilt organism as *Sclerotium rolfsii*, in recognition of Rolfs' pioneer work.

Jasmine (*Jasminum sambac* Ait) is a shrub.

bearing attractive fragrant flowers, and is commonly grown in horticultural and private gardens. Jasmine wilt caused by *S. rolfii* was first reported in Formosa by Goto in 1933. The present record of Sclerotium wilt from Bangalore is of interest since no *Sclerotium* species is reported on *J. sambac* from India.

In laboratory, a pure culture of the fungus was obtained on potato dextrose agar and identified as *S. rolfii*. The disease symptoms were drooping as though suffering from lack of water, followed by the death of the entire plant. White mycelium was found generally girdling the roots and the sclerotia were found adhering to the roots of the wilted plants.

Pathogenicity was established by inoculating the healthy jasmine plants which were grown in pots with sterilized soil. The inoculum was placed by scooping the soil round the roots for about 6 mm. and then the soil was covered. The plants were kept in the moist inoculation chamber for two days and then watered. The plants showed the typical symptoms of wilting in six weeks after inoculation. Initially a web of white mycelium was seen on the plant at the soil level as well as on the soil around the plant after one week of inoculation. Later, the white mycelium disappeared and masses of brown sclerotia about the size and colour of mustard seeds were seen at the collar region. By the time the sclerotia were formed, the lower region of the stem was girdled resulting in ultimate death of the plant. The fungus was re-isolated and confirmed as *S. rolfii*.

The fungus is confined largely to the root tissues though it may advance up the stem and kill it slightly above the surface of the soil. The roots are the main tissues invaded normally by the wilt fungus, and are very quickly killed.

Pure culture of the fungus grown on potato dextrose agar plates at room temperature for 5 days showed abundant radial growth of white, septate, branching mycelium. Sclerotia in culture were formed within 7-9 days. At first they were small, round, whitish, later turning to dark to olivaceous brown. Sclerotia taken from agar plates measured 0.5-1.5 mm. in diameter.

Division of Plant Pathology, N. SHIVANANDAPPA.
Agricultural Research Inst., H. C. GOVINDU.
Hebbal, Bangalore-24, August 13, 1965.

*1. Goto K., *Trans. Nat. Hist. Soc. Formosa*, 1933, 23, 37 (*R.A.M.*, 1934, 13, 273).

*2. Rolfs, P. H., *Florida Univ. Agr. Expt. Stat. Bull.*, 1893, 21, 1.

3. Saccardo, P. A., *Note Mycologica Ann. Mycol.*, 1911, 9, 257.

*Original not seen.

LEAF BLIGHT--A NEW DISEASE OF JASMINE

A SEVERE leaf blight of Jasmine (*Jasminum officinale* Linn.) was observed on potted plants in the garden and a commercial plantation crop at the Drug Farm, Jammu, in August, 1963. The disease made its first appearance in the middle of August and continued upto the middle of April when most of the plants were defoliated.

Initial symptoms appear in the form of irregular water-soaked spots on the leaflets which turn into brown spots within two to three days. In later stages the diseased lesions enlarge causing upward curling of leaflets and wilting of the entire twig. It is often seen that infection of one or two leaflets causes death of entire leaf and once one or two leaves are affected the other living leaves also wilt and die indicating the elaboration of a toxin which is probably translocated to the unaffected parts of the twig. Infection of the entire plant causes complete defoliation with the result that there is considerable decrease in the production of flowers. Flowers produced on infected plants are smaller and often deformed.

A large number of isolations from infected leaves always yielded a pure culture of *Glomerella cingulata* (Stonem) Spauld. and Schrenk., which produced both conidia and mature perithecia in culture. The pathogenicity of the fungus was tested on potted plants of *Jasminum officinale*. A heavy spore suspension was sprayed on the plants and the inoculated plants were kept in moist chamber for 24 hours. Typical symptoms of the disease appeared within 48 hours and complete defoliation of the inoculated plants occurred within a week. The organism was re-isolated from all the inoculated plants.

Two different leaf-spots of *Jasminum officinale* have been reported earlier.¹⁻³ These have been reported to be caused by *Cercospora jasminicola* Muller and Chupp. and *Colletotrichum jasminicola* Tilak. During the studies on this disease *Cercospora* could not be isolated from any of the infected plants and the symptoms when compared with *Cercospora*-affected plants from Bangalore were found to be quite different. In case of the plants obtained from Bangalore the spots are smaller, roundish and with a thicker texture. On these infected leaves numerous spores of *Cercospora* were observed. The description of *Colletotrichum jasminicola* does not agree with the imperfect stage of the fungus isolated from Jammu area. Thus, it appears that the disease found in Jammu which has been hitherto considered as

caused by *Cercospora jasmnicola* is actually caused by *Glomerella cingulata*. This also seems to be the first record of this fungus on *Jasminum officinale*. Initial studies have shown that the fungus produces a heat stable toxic metabolite in culture.

Our grateful thanks are due to Mr. Sutton of Commonwealth Mycological Institute, London, for the help in identifying the fungus and to Dr. K. Ganapathi, Director, for facilities and encouragement.

Regional Research Lab., K. K. JANARDHANAN.
Jammu, AKHILAR HUSAIN.
November 20, 1965.

1. Muller, A. S. and Chapp, C., *Arg. Inst. Biol. Veg.* III, 1936, 1, 91.
2. *Annual Report of the Department of Agriculture, Jamaica*, 1945-46, p. 14.
3. Mundkur, B. B. and Ahmed, S., *Myc. Pap. Imp. Mycol. Inst.*, 1946, 18, 11.
4. Ramakrishnan, T. S. and Sundaram, N. V., *Proc. Ind. Acad. Sci.*, 1954, 40 B, 1, 17.
5. — and —, *Ibid.*, 1955, Sec. 41 B, 5, 189.
6. Khan, I. and Nawaz, M., *Biologia*, 1960, 6 (2), 234.
7. Ganguly, D. and Pandotra, V. R., *Mycopath. et Mycol. Appl.*, 1963, 20, 39.
8. Venkatarayan, S. V., *Rep. Dept. Agric. Mysore, Part II* (1951-52), 1956, p. 153.
9. Tilak, S. T., *Curr. Sci.*, 1960, 29 (4), 147.

A NEW SPECIES OF *NISSLIA* FROM INDIA

DURING recent investigations of Ascomycetous fungi from Marathwada (India), the author came across with dead fallen leaves of *Ficus bengalensis* L., heavily infected with a black fungus. On detailed examination the fungus was found to be new to science on the basis of host specificity and comparative morphological studies.

Niesslia muelleri SP. NOV.

Perithecia globose to ovoid, superficial, ostiolate, $90-150 \times 90-150 \mu$, provided with dark setae 4-6 in number measuring $90-155 \times 7-9 \mu$. Wall consisting of thick-walled outer cells and thin-walled inner cells. Asci ellipsoid, hyaline, bitunicate, 8-spored, pedicellate, $30-40 \times 6-8 \mu$. Ascospores 8, biserial, hyaline to slight yellow, ovoid to fusoid, two-celled, constriction at the septum, $6-8 \times 1.5-2.4 \mu$.

On dried leaves of *Ficus bengalensis* L., Aurangabad, April 1965, Leg. Ramchandra Rao and deposited in the herbarium of Marathwada University under No. MUH. 187 (Rao type).

Niesslia muelleri SP. NOV.

Perithecia globosa vel ovoidea, superficialia, ostiolata, $90-150 \times 90-150 \mu$, ornata setis brunneis 4-6, quae sunt $90-155 \times 7-9 \mu$. Parietes constant cellulis exterioribus crasse parietatis et cellulis interioribus graciliter parietatis. Asci ellipsoidei, hyalini, bitunicati, octospori, pedicellati, $30-40 \times 6-8 \mu$. Ascosporae 8, biserialae, hyalinae vel pallide luteae, ovoideae vel fusoidae, bicellulares, ad septa constrictae, $6-8 \times 1.5-2.4 \mu$.

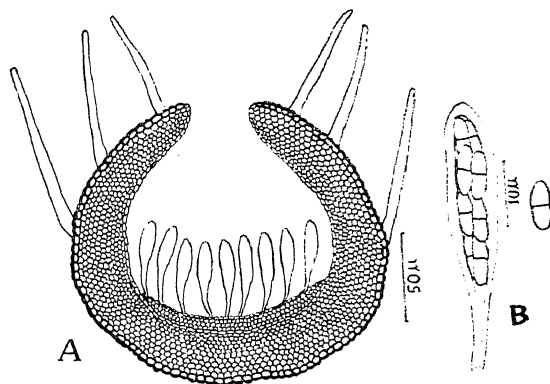


FIG. 1. A. Section through Ascocarp. B. Ascus and Ascospore.

In foliis siccis *Ficus bengalensis* L., Aurangabad, aprili 1965, Leg. Ramchandra Rao, et positus in herbario universitatis marathwadensis subnumero MUH. 187 (Rao typus.).

The species has been described after Dr. Emil Mueller, Department of Special Botany, Swiss Federal Institute of Technology, Zurich-6.

Type material is deposited in the herbarium of Commonwealth Mycological Institute, Kew, under No. IMI. 112019 and Cryptogamiae Indiae Orientalis, New Delhi, India.

Thanks are due to Dr. S. T. Tilak for guidance and encouragement, to Dr. Emil Mueller of Zurich, for his help in identification, to Dr. Ainsworth, Director, CMI, Kew, for suggestions and finally to Rev. Father Dr. H. Santapau, Chief Botanist, Botanical Survey of India, Calcutta, for Latin diagnosis of new species.

Department of Botany, RAMCHANDRA RAO.
Marathwada University,
Aurangabad, September 13, 1965.

1. *Auerswald, *Myc. Eur.*, 1869, 5, 630, ill.
2. Mueller, E., "Pilze aus dem Himalaya—II," *Sydowia*, 1958, 12, 160.

* Original not seen.

THE GENUS *PAECILOMYCES* FROM INDIA

BAINIER¹ for the first time erected the genus *Pæcilomyces* on a single species *P. varioti*. Since then many investigators²⁻⁷ have worked on this genus.

In India so far only two species of the genus *Pæcilomyces* have been reported. During the isolations of soil fungi from Uttar Pradesh and other parts of India, the authors came across the following two new records of this genus from India besides the two already reported ones, viz., *Pæcilomyces varioti* Bainier and *Pæcilomyces fusisporus* Saksena. The description of the two new records are given below :

1. *Pæcilomyces puntonii* (VUILL.) NANNIZZII

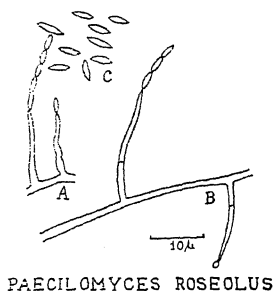
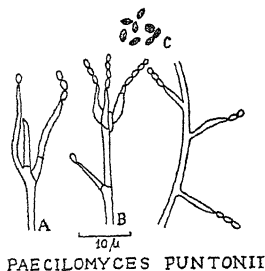


FIG. 1. *Pæcilomyces puntonii*: A and B, Branching conidiophores; C, Conidia. *Pæcilomyces roseolus*: A and B, Branching pattern of conidiophores; C, Filiform conidia.

Colonies dirty white on czapek agar, growing rapidly, covering the dish in 8 days. Conidial structure simple, consisting of phialides scattered along aerial hyphæ or funicles, singly in small group or forming small verticil on lateral branches. Conidiophores often lacking, when present, mostly short to very short, $8-24 \times 2.5 \mu$, smooth, septate, phialides $12-16 \mu$ long, with cylindrical basal portion 2.5μ in diam., tapering

gradually at the tip about 0.5μ diam., conidia cylindrical to fusiform, smooth, $3.5-5 \times 1.5-2.5 \mu$ (av. $3.5 \times 2.0 \mu$), in chains upto $90-100 \mu$ long, macrospores usually abundant, terminal or intercalary, subglobose to irregular, $4-7.0 \times 4-5.5 \mu$.

Collected from soil (Gorakhpur, India) and the culture deposited in the Commonwealth Mycological Institute as IMI-105370.

2. *Pæcilomyces roseolus* SMITH

Colonies white turning buff-coloured at maturity, growing slowly, covering the dish in 15 days. Conidial structure simple, consisting of phialides scattered along aerial hyphæ or funicles. Conidiophores smooth, septate, phialides $12-20 \mu$ long with a cylindrical basal portion tapering at the tip alternately arranged, conidia in chains filiform, smooth, $4.8-8.4 \times 1.2-2.4 \mu$ (mostly $4.8 \times 1.2 \mu$). Collected as a Laboratory contaminant at Allahabad.

This species resembles the genus *Gliobotrys*, but differs from it in various characters. In the opinion of Dr. G. Smith and Mr. Elphick of CMI it is best placed as *Pæcilomyces roseolus* Smith although differing slightly from the type culture. Culture deposited in the CMI, Kew, Surrey, as IMI-105371.

We are grateful to Mr. Elphick and Dr. G. Smith for confirming our isolates and also to Prof. J. C. F. Hopkins, Director, CMI, Kew, Surrey, England, for his kind help.

Botany Department,
University of Allahabad,
Allahabad, July 24, 1965.

A. K. SARBHOY.
D. WILLIAMSON.
S. N. BHARGAVA.

1. *Bainier, G., "Mycothique de l'Ecole de Pharmacie XI. *Pæcilomyces*, genre nouveau de Mucedinees," *Bull. Soc. Mycol. Fr.*, 1907, 23, 26.
2. Thom, C., "Cultural studies of species of *Penicillium*," *Bull. U.S. Dep. Agric. Bur. anim. Ind.*, 1910, No. 118; *The Penicillia*. Bailliere, Tindall & Cox, London, 1930.
3. *Westling, R., "Über die grünen Spezies der Gattung," *Penicillium Ark. Bot.*, 1911, 11, 1.
4. *Biourge, Ph., *Les muscardine Le genre Beauveria*, 1923.
5. Raper, K. B. and Thom, C., *A Manual of the Penicillia*, Bailliere, Tindall & Cox, London, 1949.
6. Hughes, S. J., "Studies on microfungi. XI. Some Hyphomycetes which produce phialides," *Mycol. Pap.*, CMI, Kew., London, 1951, No. 45.
7. Brown, A. H. S. and Smith, G., "The genus *Pæcilomyces* Bainier and its perfect stage *Byssoclamsys* Westling," *Trans. Brit. Mycol. Soc.*, 1957, 40 (1), 17.

* Originals not seen.

REVIEWS AND NOTICES OF BOOKS

Einstein's Theory of Unified Fields. By M. A. Tonnelat. Translated from the French by Richard Akerib. (Gordon and Breach, Science Publishers, 150, Fifth Avenue, New York), 1966. Pp. xi + 186. Price \$ 10.00.

Cutting across a multitude of original papers, the author has succeeded in synthesizing and evaluating the various points of view of the unified field theory of Einstein. This monograph begins with an exposition of the principles of the theory and analyzes the nature of the geometrical synthesis of an affine connection and a fundamental tensor of rank two which satisfies the field equations derived from a variational principle. The explicit solution of these equations tying the affine connection to the fundamental tensor gives us the balance of the work and an important research tool to further understanding of physical fields.

The contents of this volume are: Introduction; Mathematical Introduction; Field Equations—Variational Principles—Conservation Equations; The First Group of Einstein's Equations—Expression of the Affine Connection as a Function of the Fields; The Second Group of Einstein's Equations; Spherically Symmetric Solution; The Field and the Sources; Some Problems Raised by the Unified Field Theory. Appendix 1: Relations Between Determinants; Appendix 2: Application of the Variational Principle to a Density Constructed with Ricci's Tensor $R_{\mu\nu}(L)$ ($L_p = L_{p\mu\nu} = 0$); Appendix 3: Proof of the Relation

$$A_p = -q/\gamma A - 1/\gamma_p \times (g - \gamma - q) A_p$$

Appendix 4: Calculation of the Affine Connection in the Static Spherically Symmetric Case; Appendix 5: Isotropic Co-ordinate System in Unified Field Theory.

C. V. R.

Collection of Problems in Theoretical Mechanics. By Ivan Vsevolodovich Meshchersky. (Dover Publications, Inc., 180, Varick Street, New York-14), 1965. Pp. 302. Price \$ 1.50.

Ivan Vsevolodovich Meshchersky (1859-1935) was an outstanding Russian scientist and educator. Since 1914, editions of his famous *Collection of Problems in Theoretical Mechanics* have been widely used in Russia, and at present

the book is a basic text for all Soviet students of theoretical mechanics. Although a substantial portion of the original problems, dealing with basic terrestrial situations, still remains in this present work, each successive edition has undergone some slight changes (some problems deleted, others added) to keep the book current. The translation printed here is of the latest (1962) edition. Translated into English by N. M. Sinelnikova, this is an unusually comprehensive collection, containing more than 800 standard, sizable problems that embrace all the principles of a first course in mechanics, with some problems that are more advanced.

The contents of this book are as follows: Part I: Statics of Rigid Bodies: 1. Coplanar Force System; 2. Statics in Space. Part II: Kinematics: 3. Motion of a Particle; 4. Simplest Motions of a Rigid Body; 5. Composition and Resolution of Motions of a Particle; 6. A Rigid Body Motion in a Plane; 7. Motion of a Rigid Body about a Fixed Point; 8. Dynamics of a Particle; 9. Dynamics of a System; 10. Theory of Oscillations.

This collection should be of great interest and value to all engineers and physics students who would like to become familiar with the variety of applications of mechanics principles.

C. V. R.

The Theory of Electromagnetic Waves. Edited by Morris Kline. (Dover Publications, Inc., 180, Varick Street, New York-14), 1965. Pp. viii + 393. Price \$ 3.00.

This is an unabridged and unaltered republication of the work first published by Interscience Publishers, Inc., New York, in 1951.

The articles in this book were originally presented at a symposium held under the auspices of the Washington Square College of Arts and Science, the Institute for Mathematics and Mechanics of New York University and the Geophysical Research Directorate of the Air Force Cambridge Research Laboratories, June 6-8, 1950.

The contents include such subjects as: Wave Propagation in Stratified Media; Problems of Wave Propagation over Rough Surfaces and around the Surface of the Earth; Extension of Weyl Integral; Radiation and Diffraction Problems in Spherically Stratified Regions; Diffraction Theory of Gaussian Optical Systems;

Diffraction of Electromagnetic Waves by an Aperture in an Infinite Plane Conducting Screen, Between Two Paralleled Planes, and by Wedges and Corners. Other papers concern Asymptotic Solutions of the Vector Wave Equation; An Asymptotic Solution of Maxwell's Equations; A Geometric-Optical Series Based on the W.K.B. Approximation; The Nature of Spectra of Both Ordinary and Partial Differential Operators; and The Triple Splitting of Ionospheric Waves.

Problems are approached throughout from a mathematical point of view based on Maxwell's equations. This volume will be of interest to all those working in appropriate fields of applied mathematics and research engineering.

C. V. R.

Optical Properties of Thin Solid Films. By O. S. Heavens. (Dover Publications, 180, Varick Street, New York-14), 1965. Pp. vii + 261. Price \$2.00.

This Dover edition, first published in 1965, is an unabridged and corrected republication of the work first published by Butterworths Scientific Publications, Ltd., in 1955.

The titles of the chapters contained in this book are as follows: 1. Introduction; 2. The Formation of Thin Films; 3. The Structure of Solid Films; 4. Thin Film Optics; 5. Measurements of Film Thickness and Optical Constants; 6. Results of Optical Measurements on Films; 7. Practical Applications of Thin Films in Optics.

Theory and practical details are emphasized equally in this text. A slight background in differential equations is helpful in following the theoretical portions of the text, but the mathematical basis will not impede those who are chiefly interested in experimental techniques and results.

C. V. R.

Documents on Modern Physics: Superconductivity. By M. Tinkham. (Gordon and Breach, Science Publishers, 150, Fifth Avenue, New York), 1966. Pp. 86. Price \$4.50.

The scope of this book is indicated by the titles of the chapters listed below: I. Basic Properties of Superconductors; II. Early Theories; III. More Recent Developments; IV. Bardeen-Cooper-Schrieffer Theory—Equilibrium Properties; V. Alternate Formulations of the BCS Theory; VI. BCS Theory—Dynamic Properties of Superconductors; VII. Ginzburg-Landau-Gor'kov Theory and Related Topics.

C. V. R.

Energetics in Metallurgical Phenomena (Vol. II). Edited by William M. Mueller. (Gordon and Breach, Science Publishers, Inc., 150, Fifth Avenue, New York), 1965. Pp. 209. Price: Cloth \$11.00; Paper \$5.50.

This volume represents the proceedings of the 1963 Seminar on Energetics in Metallurgical Phenomena held at the University of Denver.

The contents of the volume are: The Kinetic and Thermodynamic Properties of Surfaces: Surface Energy, Surface Diffusion, and Growth and Dissolution or Evaporation Processes, by J. P. Hirth; Solid Solution Formation, by B. L. Averbach; The Statistical Mechanics of Nucleation and Crystal Growth, by G. M. Pound; Point Defects in Metals, by G. J. Dienes.

C. V. R.

The Amino Sugars (Vol. II B)—Metabolism and Interactions. Edited by Endre A. Balazs and Roger W. Jeanloz. (Academic Press, New York and London), 1966. Pp. xviii + 516. Price \$22.00.

This volume presents the metabolism of amino sugar-containing macromolecules and their interactions with other molecules, viruses and cells, as well as with radiation.

The titles of the chapters in this book are as follows: Metabolism of Amino Sugars, by Eugene A. Davidson; Metabolism of Glycosaminoglycans, by Harry Bostrom and Lennart Roden; Metabolism of Glycoproteins, Glycopeptides and Glycolipids, by Ikuo Yamashina; Effect of Steroid Hormones on the Glycosaminoglycans of Target Connective Tissues, by J. A. Szirmai; Hexosaminidases, by P. G. Walker; Neuraminidases, by Max E. Rafelson, Jr., Michael Schneir and Vannie W. Wilson, Jr.; Enzymes Degrading Glycosaminoglycans, by Heinz Gibian; Sulfatases of Glycosaminoglycans, by K. S. Dodgson; Activation and Inhibition of Enzymes by Polyanions Containing Amino Sugars, by Peter Bernfeld; Chemical and Physical Changes of Glycosaminoglycans and Glycoproteins Caused by Oxidation-Reduction Systems and Radiation, by Lars Sundblad and Endre A. Balazs; Interaction of Polyanions with Blood Components, by Peter Bernfeld; Immunochemistry, by Georg F. Springer; Interaction between Glycoproteins and Viruses, by Alfred Gottschalk; Interaction of Amino Sugars and Amino Sugar-Containing Macromolecules with Viruses, Cells and Tissues, by Endre A. Balazs and Bernard Jacobson.

C. V. R.

The Dynamics of Conduction Electrons. By A. B. Pippard. (Gordon and Breach, Science Publishers, 150, Fifth Avenue, New York), 1965. Pp. 150. Price: Paper \$1.95; Cloth \$4.95.

This monograph which is one in the series *Documents on Modern Physics*, is the text of carefully prepared notes by the author for a course of lectures on the subject, and they elucidate the physical processes involved in electronic phenomena making use of semi-classical methods. The discussions include the Boltzmann Transport Equation, the Anomalous Skin Effect, Galvanomagnetic Effects, the de Haas-van Alphen Effect, Acoustic Attenuation, and Cyclotron Resonance. A. S. G.

Technical Thermodynamics. By V. V. Sushkov. Pp. 397. Price \$9.50.

Basic Electrical Engineering. By A. Kasatkin and M. Perekalin. Pp. 386. Price \$9.50.

These two books form Volume XX and Volume XXIII of the series *Russian Monographs and Texts on Advanced Mathematics and Physics* (English translations from Russian texts) published by Gordon and Breach, Science Publishers, 150, Fifth Avenue, New York-11. They will provide suitable supplementary reading for students of engineering in technical institutions. A. S. G.

Dictionary of Economic Plants in India. By P. Maheshwari and Umrao Singh. (Indian Council of Agricultural Research, New Delhi), 1965. Pp. 197. Price Rs. 9.50.

The *Dictionary* lists over 1,700 species of economic plants, in alphabetical sequence of their scientific names. The name of the family is given after each plant and then the English and the Hindi names (in Roman script). This is followed by brief information on habit, distribution and uses. An Index of English and Hindi names included at the end will prove useful to lay readers. A. S. G.

Social Insect Populations. By M. V. Brian. Academic Press, Inc., London, Ltd., London W. 1), 1965. Pp. 135. Price 35 sh.

Social insects are interesting ecologically, since they combine certain characteristics of plants and animals. They are variously organized, some into distinct colonies which are closed to others of the same and different species, some into colonies that are diffuse and only closed to members of other species or subspecies, and there are all forms of intermediates.

The book is essentially a collection of information from widely scattered and disconnected observations on populations of social insects. Ants, bees, and wasps predominate in the discussion but termites and the European honey-bee *Apis mellifera* have also been mentioned. An appendix includes more than 400 references.

The book should be found useful to research workers in this particular field, and also appeal to general readers interested in natural history.

A. S. G.

Advances in Child Development and Behaviour (Vol. 2). Edited by Lewis P. Lipsitt and Charles C. Spiker. (Academic Press, New York and London), 1965. Pp. 269. Price \$8.50.

The volume provides critical review articles in specialised fields of research in child psychology and developmental psychology. Teachers and research workers concerned with child development will find up-to-date information in this series. Contents of Volume 2 are: The Paired-Associates Method in the Study of Conflict, by A. Castaneda; Transfer of Stimulus Pretraining in Motor Paired-Associate and Discrimination Learning Tasks, by J. H. Cantor; The Role of the Distance Receptors in the Development of Social Responsiveness, by R. H. Walters and R. D. Parke; Social Reinforcement of Children's Behaviour, by H. W. Stevenson; Delayed Reinforcement Effects, by G. Terrell; A Developmental Approach to Learning and Cognition, by E. S. Gollin; Evidence for a Hierarchical Arrangement of Learning Processes, by S. N. White; Selected Anatomic Variables Analyzed for Interage Relationships of the Size-Size, Size-Gain, and Gain-Gain Varieties, by H. V. Meredith. A. S. G.

Books Received

Science and Society Selected Essays. By A. Vavoulis and A. W. Colver. (Holden-Day, Inc., 728, Montgomery Street, San Francisco), 1966. Pp. 152. Price: Cloth \$5.45; Paper \$2.75.

Annual Review of Psychology (Vol. 17). (Annual Reviews, Inc., 231, Grant Avenue, Palo Alto, California 94306, U.S.A.), 1966. Pp. ix + 589. Price \$9.00.

Annual Review of Physiology (Vol. 28). (Annual Reviews, Inc., California, U.S.A.), 1966. Pp. 571. Price \$9.00.

High Energy Physics. Edited by C. DeWitt and M. Jacob (Gordon and Breach, Science Publishers, Inc., New York), 1965. Pp. xi + 509. Price: Cloth \$10.50; Paper \$8.50.

Announcements

International Conference on Spectroscopy

An International Conference on Spectroscopy is being organised in Bombay from January 9 to 18, 1967, by the Department of Atomic Energy and co-sponsored by IAU, IUPAC and IUPAP. The Conference will cover radio-frequency and microwave spectroscopy (including NMR, ESR, etc.), infra-red, Raman and optical spectroscopy of atoms and molecules. All persons who would like to attend the Conference are invited to inform the Secretary, Organising Committee, as soon as possible and those who, in addition, would like to present papers (15 minutes duration) should send in the titles of the papers and abstracts by September 1, 1966. Further enquiries may be addressed to the Secretary, Organising Committee, A.E.E.T., Spectroscopy Division, 414 A, Cadell Road, Bombay-28.

Symposium on Electrode Processes

A Symposium on *Electrode Processes*, sponsored by the University Grants Commission, is being organised at the Chemistry Department of the University of Jodhpur and will be held from November 1st to 5th, 1966. The Symposium is meant for research workers having interest in the field of electro-chemistry. Intending participants should send a short summary of the paper, which they wish to present at the Symposium, to Prof. R. C. Kapoor, Director of the Symposium, University of Jodhpur, Jodhpur, latest by the 31st August 1966.

Indian National Scientific Documentation Centre

Insdoc is compiling a Central Roster of Scientific Translators. Persons possessing scientific qualifications and proficiency in any of the foreign languages except English will be enrolled in the Roster. Further particulars can be obtained from the Director, INSDOC, Hillside Road, Delhi-12.

Digital Searching Services for Spectra

Scientific Documentation Centre Ltd., Halbeath House, Dunfermline, Fife, United Kingdom, informs us: The Centre has 64,000 Infra-red Spectra and 19,000 on Ultra-violet Spectra coded on 80-column punched cards (ASTM data). These spectra can be searched by spectrum (coded to 0.1 micron), by chemical structure (a very detailed structural code is

used) or by empirical formula (for C, N, O and S), or by elements (for the less common elements), or by any combination of these giving a very powerful tool for identifying chemical unknowns. Originals of all punched cards and of many of the printed spectra from these collections are available from the Centre on loan to Members.

Award of Research Degrees

Andhra University has awarded the Ph.D. degree in Physics to Sri. B. Lokanadhan for his thesis entitled "Studies on Meteors of November, December and January and Their Influence on Terrestrial Atmosphere"; Ph.D. degree in Chemistry to Sri. C. Suryaprakasa Sastry for his thesis entitled "The Triterpenes of *Barringtonia acutangula* Gaertn. and other Plants of Lecythnidaceae"; D.Sc. degree in Geology to Sri. V. V. S. S. Tilak for his thesis entitled "Some Aspects of the Geochemical Dispersion Patterns in the Uranium Prospect at Umra, Rajasthan"; D.Sc. degree in Technology to Sri. R. Krishna Murty for his thesis entitled "Studies on Perforated-Plate Liquid-Liquid Extraction Towers".

Utkal University has awarded the Ph.D. degree in Chemistry to Sri. K. K. Patnaik for his thesis entitled "Studies on Some Plant Products (Fixed Oil) and Antispasmodics".

Sri Venkateswara University has awarded the Ph.D. degree in Physics to Sri. R. Gopalakrishnan for his thesis entitled "Magnetic Studies in Binary Liquid Mixtures".

Indian Association of Biological Sciences

The various branches of biology are becoming too specialised, and there has arisen a need for greater communication and contacts among the biologists. In this context the Indian Association of Biological Sciences was founded by a group of biologists led by the late Professor P. Maheshwari, F.R.S., at a meeting held at Calcutta in January 1965. Further particulars about the Association regarding aims and objects, membership, etc., can be had from Prof. B. M. Johri, Secretary, I.A.B.S., Department of Botany, University of Delhi, Delhi-7.

ERRATUM

Current Science, 1966, Vol. 35, p. 142, line 7
For in those species (*B. pholis* and *C. gunnellus*)
Read in species like *G. minutus* and *O. punctatus*.

STUDIES ON THE PREPARATION OF SOME ISOTOPICALLY LABELLED ORGANIC IODO COMPOUNDS FOR MEDICAL USE

R. S. MANI

Isotope Division, Atomic Energy Establishment, Trombay

1. INTRODUCTION

SEVERAL water-soluble organic iodo compounds have been used in medicine as contrast media. Diodrast (3, 5-diiodo-4-pyridone-N-acetic acid), Cholographin (adipyl imino bis 2, 4, 6-tri-iodo benzoic acid), iopanoic acid (2 ethyl-3, 3'-amino 2, 4, 6-tri-iodo phenyl), propionic acid and Triumbren, 3-acetamido 2, 4, 6-tri-iodo benzoic acid have been used for the visualisation of the kidney and the gall bladder. Labelling these compounds by iodine-131 will greatly facilitate such studies, rendering possible external scanning techniques. Iodine-131 labelled Hippuran (sodium ortho iodo hippurate) and para amino hippurate (PAH) are also useful in studies of kidney function. Methods have been suggested for labelling these compounds with iodine-131 based on direct exchange between the compounds and NaI-131 or elemental iodine or iodine monochloride.¹⁻³ The author found that traces of impurities present in the iodine-131 solution used for labelling greatly influence the yield and purity of the labelled products. The effect of these impurities has been studied in detail here and methods have been developed for the preparation of the pure labelled compounds.

EFFECT OF REDUCING AGENTS

Iodine-131 is usually produced by a wet distillation method from pile irradiated tellurium metal,^{4,5} and is likely to contain traces of sulphite and oxalate and metallic impurities such as manganese and copper. In some commercially available samples of iodine-131 cysteine, glutathione, and benzyl alcohol are also present, the former as preservations and the latter as a bacteriostatic agent.

(a) Tracer studies have been carried out here, using carrier-free iodine-131 (0.1-1 mc. NaI-131) to which are added 5-50 micromoles of sulphite or oxalate or cysteine hydrochloride and the iodide heated under reflux with the iodo compounds for 2-6 hours. From the mixture the labelled iodo acid is separated and purified by repeated precipitation with dilute acid, or by paper chromatography, and the radiochemical yield determined. The experiments were repeated, using NaI-131 solution containing 10 to 100 parts per million of manganese and

copper. It was found the yield was only slightly lower in solutions containing sulphite and oxalate. However, solutions containing copper and cysteine gave very poor yields.

(b) The reducing agent content of the iodine-131 solution (NaI-131) was estimated by a micro-titration using 0.01 N potassium permanganate solution. To the NaI-131 solution (pH 8-9) was added 10-20% excess of one of the following oxidising agents: hydrogen peroxide (100 volumes), chloramine-T (freshly prepared solution), potassium iodate, potassium dichromate, potassium permanganate, and sodium nitrite (freshly prepared solution) and the labelling experiments repeated. It was found that in all cases labelling was facilitated if the oxidising agent added was in slight excess of the reducing agent content of the iodine-131 solution. Hydrogen peroxide and chloramine-T gave the best labelling yields (80-95%). In batches of NaI-131 containing initially $> 10^{-5}$ equivalents of reducing agents per millilitre, the use of KIO_3 as the oxidising agent gave low yields, possibly because of the formation of iodide by reduction of the KIO_3 . Aliquots of the NaI-131 solution (pH 8-9) treated with these oxidising agents have been analysed by paper chromatography using 70% aqueous methanol as solvent. It was found that 15-40% of the iodine-131 activity was present in the form of iodate (R_f IO_3 0.4, R_f I^- 0.7-0.8). The use of excess oxidants, however, tends to decompose the iodo compounds, giving rise to labelled iodo benzoic acids.⁶

EFFECT OF CARRIER IODIDE AND OTHER ANIONS

(a) The exchange experiments were carried out using 100-250 milligrams of the iodo compounds and sodium iodide- I^{131} or sodium iodide- I^{131} with chloramine-T or hydrogen peroxide, known amounts of carrier sodium iodide being added to the carrier-free NaI-131 solution. The exchange yield was determined by paper chromatography using dilute hydrochloric acid solution (0.1 M) (R_f of the free iodo acids 0, R_f of iodide- I^{131} 0.7-0.8). It was found that the yield falls off from 80-90% for carrier-free iodine-131 to $< 15\%$ in the presence of 10^{-4} moles of carrier iodide.

(b) The exchange experiments were repeated using 100-250 milligrams of the iodo compounds

and iodine-131 in the form of elemental iodine in aqueous solution (0.1 ml. of 0.01N KI solution, 0.1 ml. of 0.005N KIO_3 solution and 2 drops of 1N H_2SO_4 added to the NaI-131 solution, followed by 1 ml. of 1M acetate buffer for adjusting the pH to 5-6). It was found that 80-90% yield was obtained when the carrier added did not exceed 10^{-6} moles.

(c) The absence of unbound iodide in the iodo compounds was confirmed by precipitating 250 milligrams of these compounds by phosphoric acid and assaying the supernate spectrophotometrically. Less than 100 ppm. of unbound halogens was found to be present in the samples used.

(d) The exchange experiments were repeated using carrier-free NaI-131 solution to which was added varying concentrations (10^{-2} to 1 mM) of chloride or sulphate or phosphate. It was found that the radiochemical recovery was less in the presence of chloride and practically unaffected by the presence of sulphate or phosphate.

THE RADIOCHEMICAL PURITY OF THE LABELLED PRODUCTS

(i) The radiochemical purity of the iodine-131 labelled iodo compounds was studied by paper chromatography and electrophoresis. For the tri-iodo benzoic acid derivatives, 1N hydrochloric acid solution was used as the developing solvent (R_f of the free acids 0, R_f of iodide 0.8). For Hippuran, butanol : acetic acid : water mixture (4 : 1 : 1) was used as the solvent (R_f of Hippuran 0.9, R_f of iodide 0.2-0.3). For electrophoresis, dilute acetate of phosphate buffer solutions have been used (pH 5.5-8)—the unbound iodide and the free iodo-benzoic acids migrate ahead of the labelled derivatives.⁹ In all cases, it was found that the purity of the labelled products exceeds 95%.

(ii) The radiochemical purity of the products was also studied by column chromatography over DEAE Sephadex A.25. On elution with sodium chloride solution 0.1-1 molar, it was found in tracer experiments, that the labelled iodo acid derivatives and unbound iodine were eluted in that order.⁶ The products prepared were found to be radiochemically pure (95%).

(iii) The radiochemical purity was also studied for products prepared by :

(a) Direct exchange between NaI^{131} and the compounds, carried out in acetate buffer solution, by refluxing the mixture for 12-16 hours at about 80°C .

- (b) Exchange using NaI^{131} and oxidising agents such as chloramine-T, H_2O_2 , potassium persulphate, KIO_3 and KMnO_4 .
- (c) Exchange between the iodo compounds NaI^{131} containing different amounts of carrier NaI.

It was found that :

The compounds do not undergo degradation during the 16 hours of heating. The use of excess of oxidants such as H_2O_2 tends to decompose some of these compounds, example, Cholographin, and the labelled product, on chromatographic analysis, shows the presence of the labelled degradation products also. The distribution of the I-131 activity among the pure compounds and the degradation products is unaffected on addition of carrier iodide, thereby showing that carrier-free I-131 is not selectively utilised by impurities or foreign bodies present in the iodo compounds.

(iv) The pure iodine-131 labelled compounds (100 micromoles) were heated in solution, in presence of 50 micromoles of cysteine, oxalate, sulphite or copper acetate for 1-3 hours at pH 5-6 and the mixture analysed by paper chromatography (using dilute HCl as solvent). It was found that cysteine and copper acetate deiodinate the compounds, giving rise to unbound iodine-131 activity. However, the deiodination is less pronounced than in the case of the iodinated fluorescein derivatives such as tetra-iodo tetrachlorofluorescein.⁶

(v) To the NaI^{131} solution were added 50-100 micromoles of one of the following: Cysteine, oxalic acid, copper sulphate and manganous sulphate. The I-131 solution was then treated as follows :

- (a) The solution was buffered at pH 8.5-9 and concentrated to the point of dryness in a stream of oxygen, allowed to cool, and then used for labelling. An aliquot of this solution is analysed by paper chromatography using 70% methanol as solvent.
- (b) To the I-131 solution were added 10 micrograms of iodide carrier, 1-2 ml. of concentrated H_2SO_4 and a few drops of H_2O_2 (with cooling) and the iodine-131 distilled into ice-cooled water. This solution was then used for labelling.
- (c) From the NaI^{131} solution, the iodine was distilled off by the procedure of Freedman *et al.*⁷ and the distillate used for labelling.

It was found that in all cases, the distilled I-131 gave very satisfactory results. However, concentration in presence of oxygen did not give satisfactory recovery when the I-131 solution

contained cysteine.⁶ High yields were also obtained when iodine-131 prepared by the dry distillation of pure tellurium dioxide^{6,8} or by the dissolution of irradiated tellurium in sulphuric acid and hydrogen peroxide⁶ was used for labelling.

CONCLUSION

Iodine-131 used for the preparation of labelled compounds should be free from reducing agents and preservatives, to ensure high yields. It is preferable to purify such solutions by redistillation from H_2SO_4 solution.

1. Lieber, J. and Andrysek, O., *Nature*, 1959, **184**, 913.

2. Mitta, A. and Farga, A., *Int. J. Appl. Radn. and Isotopes*, 1961, **12**, 146.
3. Tubis, M. and Posnick, E., *Proc. Soc. Exptl. Biol. and Med.*, 1960, **103**, 497.
4. Kenny, A. W. and Spragg, W. T., *AERE. C/R*, 1964, p. 349.
5. Iya, V. K., Murthy, T. S., Balasubramanian, K. R., Ramachandra, M. and Nair, V. C., *AEET/ Radiochem* 50, 1964.
6. Mani, R. S. (Unpublished observations).
7. Kahn, M., Freedman, A. J. and Schultz, C. G., *Inorganic Synthesis*, McGraw-Hill Book Co. Inc., New York, 1957, Vol. J, 166.
8. Evans, C. C. and Stevenson, H., *Brit. Patent No.* 763, Dec. 1956, p. 865.
9. Gopal, N. G. S. (To be published).

CYTOTOXIC AND RADIOMIMETIC ACTIVITY OF IRRADIATED CULTURE MEDIUM ON HUMAN LEUKOCYTES

P. C. KESAVAN AND M. S. SWAMINATHAN

Indian Agricultural Research Institute, New Delhi

ALTHOUGH as early as 1947, Stone, Wyss and Haas¹ reported the incidence of mutations in *Staphylococcus aureus* cultured on ultra-violet irradiated substrate, interest in the study of the indirect effects of radiations as measured by the effects observed in unirradiated test organisms grown on irradiated media, has been negligible until recently. During 1955-65, Swaminathan and co-workers carried out a series of experiments²⁻⁶ which indicated that in a wide range of material such as potatoes, fruit juices, and different types of culture media, cytotoxic and radiomimetic compounds are generated following exposure to dosages of gamma-rays of the order used in the pasteurization and sterilization of food. The precise biochemical nature of these compounds has not yet been identified, although data suggesting that they may not be short-lived were obtained.⁶ Recently, Holsten, Sugii and Steward⁷ have confirmed these observations and have further provided evidence for the formation of some new chemical substances in irradiated culture media containing sugar. The present paper relates to observations made during mitosis in human leukocytes cultured on irradiated medium.

Using a slight modification of the technique of Moorhead *et al.*,⁸ mitosis was studied in leukocyte cultures from four different healthy human males, ranging from 20 to 30 years in

age. The composition of the medium was as follows:

- | | |
|---------------------------------|------------|
| (a) T.C. 199 | .. 7 ml. |
| (b) AB human serum | .. 1.5 " |
| (c) Bacto-Phytohaemo-glutinin M | .. 2 drops |

In one set of cultures, normal T.C. 199 was used and in the other, T.C. 199 exposed in intact vials to different dosages of gamma-rays in a 2000-Curie Co^{60} source was added.

The prominent effects observed in cultures in which irradiated T.C. 199 was used, were (a) a considerable inhibition of mitosis, (b) pyknosis, chromosome fragmentation and polyploidy and (c) micronuclei formation at telophase (Table I). Thus, the effects on mitosis, as observed in leukocytes, are similar to those earlier reported in plant meristems. When the T.C. 199 medium was irradiated, stored in a refrigerator for 15 days and then used, the cytotoxic properties persisted.

We have pointed out in several of our earlier papers that the radiomimetic effects produced by the irradiation of culture media are small (about 1% in relation to the effect of direct irradiation) and can be demonstrated in most cases only in relation to controls of comparable size. In recent literature there are reports both supporting our findings and contradicting them.⁹⁻¹⁷ There have been extreme views on the implications of the results obtained in such

TABLE I

Observations during mitosis in human leukocyte cultures

Case No.	Medium and dose	No. of days of storage of medium	No. of leukocytes analysed	Mitotic index	No. of cells studied at mitosis	Percentage of cells with abnormalities					Total No. of cells with abnormalities during division
						Polyploid cells	Gaps and breaks	Fragmentation	Micro-nuclei at interphase		
I a	Control	1	6401	2.99	20	0	0	0	0	0	0
b	Irradiated (0.10 mega rads)	1	2294	0.21	9	0	22.22	66.66	11.00		88.88
II a	Control	7	4779	7.95	26	0	3.84	0	0		3.84
b	Irradiated (0.10 mega rads)	7	2635	0.30	8	0	0	62.50	16.50		62.50
III a	Control	9	9199	3.42	34	0	5.88	2.94	0		8.82
b	Irradiated (0.50 mega rads)	9	2194	0.31	16	0	12.50	43.75	0		56.25
IV a	Control	15	5743	17.17	59	3.38	0	5.08	0		8.46
b	Irradiated (0.50 mega rads)	15	2832	0.67	19	5.26	21.05	36.84	13.60		63.15

studies. While on the one hand Holsten *et al.*⁷ hold that the work has obvious bearing on the radiation-sterilization of food, especially in cases in which the irradiated material is relatively rich in sugar, Goldblith¹⁸ feels that the data already available indicate that irradiated food 'can be consumed with impunity'. Radiation sterilization of food is a very important technological development and could find even more application in the developing countries, than in the developed ones. It is hence desirable that the products and pathways of the indirect effects of radiations are studied critically. Goldblith¹⁸ believes that even if cytotoxic products are produced in irradiated food, they may be of no consequence since animal systems have 'mechanisms for modification, alteration and digestion of the foods by the alimentary tract and the detoxification and excretion mechanisms of the liver and kidney'. The extensive data now available on the wholesomeness of irradiated food unfortunately all relate to somatic effects and no serious study has been made to detect possible genetic harm. At the level of genetics, there is a remarkable unity in the biological world in their response to mutagenic agents. Elegant genetic tests such as those used by Russel¹⁹ in mice are available for obtaining critical data within a short time which would help in drawing scientifically satisfactory conclusions. In view of the great economic attractiveness of radiation food

technology, support for such research would be extremely prudent.

1. Stone, W. S., Wyss, O. and Haas, F., *Proc. Natl. Acad. Sci. U.S.*, 1947, **33**, 59.
2. Natarajan, A. T. and Swaminathan, M. S., *Ind. J. Genet.*, 1958, **18**, 220.
3. Swaminathan, M. S., Chopra, V. L. and Bhaskaran, S., *Radiation Research*, 1962, **16**, 182.
4. —, Satya Nirula, Natarajan, A. T. and Sharma, R. P., *Science*, 1963, **141**, 637.
5. Chopra, V. L., Natarajan, A. T. and Swaminathan, M. S., *Radiation Botany*, 1963, **3**, p.1.
6. — and Swaminathan, M. S., *Naturwissenschaften*, 1963, **10**, 374.
7. Holsten, R. D., Sugii, M. and Steward, F. C., *Nature*, 1965, **208**, 850.
8. Moorhead, P. S., Nowell, P. C., Mellman, W. J., Batipps, L. M. and Hungerford, D. A., *Expt. Cell Res.*, 1960, **90**, 613.
9. Reinhardt, R. R. and Ratty, F. J., *Genetics*, 1965, **52**, 1119.
10. Chopra, V. L., *Microbial Genetics Bulletin*, 1965, **23**, 8.
11. Om Prakash, *Nature* 1965, **205**, 312.
12. Molin, N. and Ehrenberg, L., *Int. J. Rad. Biol.*, 1965, **8**, 223.
13. Berry, R. J., Hills, P. R. and Trillwood, W., *Ibid.*, 1965, **9**, 559.
14. Moutschen, J. and Matagne, R., *Radiation Botany*, 1965, **5**, 23.
15. Chopra, V. L., *Nature*, 1965, **208**, 699.
16. Reddy, O. S., Reddy, G. M., Rao, J. J., Ebenezer, D. N. and Rao, M. S., *Ibid.*, 1965, **208**, 702.
17. Khan, A. H. and Alderson, T., *Ibid.*, 1965, **208**, 700.
18. Goldblith, S. A., *Ibid.*, 1966, **210**, 433.
19. Russel, W. L., *Cold Spring Harbor Symposia Quant. Biol.*, 1951, **16**, 327.

NUCLEAR MAGNETIC RESONANCE IN LIQUID In-Bi SYSTEM

D. L. RADHAKRISHNA SETTY AND B. D. MUNGURWADI

Tata Institute of Fundamental Research, Bombay-5

BLOEMBERGEN AND ROWLAND¹ obtained remarkable results in liquid thallium (10% thallium) amalgam. ²⁰⁵Tl Nuclear Magnetic Resonance (NMR) line-width has the same order of magnitude as in the solid phase and is apparently not narrowed by the rapid motion in the liquid. In addition they observed an increase of 20% Knight shift of ²⁰⁵Tl on melting one of the amalgams which was attributed to change in the electronic structure on melting. Knight *et al.*² have carried out a more systematic and exhaustive study of liquid metals. Their experimental observations point to the conclusion that a liquid must have an electronic band structure similar to that of a solid and is determined essentially by the short-range atomic structure which usually does not change on melting.

Rimai and Bloembergen³ investigated the Na-K and Na-Rb alloys in liquid state by NMR method. The shifts have been found to change smoothly with the composition in each case and do not show composition inhomogeneity broadening of the type described in solid alloys.

Seymour *et al.*⁴ have studied liquid In-Sn, In-Tl and Bi-Pb by NMR method. They observed that a free electron picture holds good fairly well in liquid In-Sn but not in In-Tl. By following the concentration dependence of the Knight shift of ²⁰⁹Bi in Bi-Pb they inferred that the electronic structure is mainly determined by the short-range atomic structure.

We undertook the NMR study of liquid In-Bi system to verify whether, or not, a free electron picture holds good in this system.

One of the forms of expressing Knight shift is

$$K = \frac{8\pi}{3} \chi_p M P_r$$

where P_r is the probability density at the nucleus for electrons at the Fermi surface, χ_p is the paramagnetic susceptibility per unit mass and M is the atomic mass. The volume dependence of χ_p and P_r are not known with accuracy. For a free electron model

$$\chi_p \propto v^{\frac{1}{3}} n^{\frac{1}{3}} \text{ and } P_r \propto v^{-1}$$

where v is the atomic volume and n is the number of free electrons per atom. Inverse dependence of P_r on v arises because of normalization of the electron wave function. If n is varied by alloying metal A (solvent) with another metal B (solute) then the fractional change in the

Knight shift of the solvent at the solute concentration, C , under free electron model is given by

$$\frac{\Delta K}{K} = \left[\frac{1 - C + \left(\frac{n_B}{n_A}\right) C}{1 - C + \left(\frac{v_B}{v_A}\right) C} \right]^{\frac{1}{3}} - 1 \quad (1)$$

where K is the Knight shift in pure metal A. In deriving equation (1) no account has been taken of the screening effect on the impurity atoms as this will, any way, not improve the situation in In-Bi system.⁵

Knight shifts of ¹¹⁵In and ²⁰⁹Bi in liquid In-Bi system at various concentrations have been measured at 200° and 285° C. respectively. The corresponding shifts in pure liquid metals have also been measured which are in agreement within the experimental errors with those reported in the literature.⁶ Observed fractional changes in the Knight shift, $\Delta K/K$, of ¹¹⁵In and ²⁰⁹Bi resonances in In-Bi system have been plotted as a function of concentration in Fig. 1. The corresponding theoretical curves

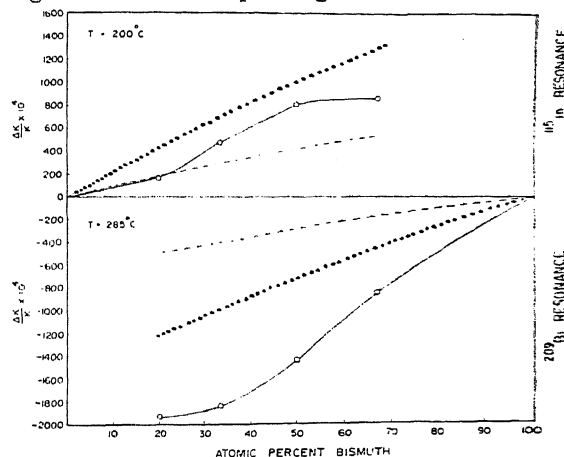


FIG. 1. Fractional changes in Knight shift of ¹¹⁵In and ²⁰⁹Bi as a function of concentration in liquid In-Bi. The full lines denote the experimental values. The calculated values with and without volume correction are indicated by broken and dotted lines respectively.

calculated, with and without volume correction, by using equation (1) are also shown in the same figure. The curves without volume correction have been drawn assuming $v_A = v_B$. Figure 1 clearly indicates that the electronic band structure of liquid In-Bi system is far from the free electron picture. It is

interesting to note that in the case of bismuth, the experimental curve is closer to the calculated one without volume correction. It may be recalled that the Knight shift of ^{209}Bi in pure liquid metal is insensitive to changes in volume.⁶

In the course of writing this paper the authors have noticed a similar work reported by Seymour and Styles.⁵ Their experimental results more or less agree with ours though there is slight discrepancy in the Knight shift values quoted for ^{209}Bi resonance at low concentrations of bismuth. They elegantly explained the observed shifts qualitatively by assuming that the intermetallic compounds, InBi and In_2Bi , retain their ordered structures in the liquid state. This is unlikely as the Knight shift of ^{115}In resonance in InBi intermetallic compound in the solid state is very small ($\sim +0.27\%$ at

$80^\circ\text{C}.$) compared to that of InBi in the liquid state. (A detailed paper on the NMR in InBi intermetallic compound will be published elsewhere.) Presumably we have in the liquid state more or less a homogeneous mechanical mixture of indium and bismuth and no intermetallic compound is formed at this composition.

The authors are indebted to Dr. C. R. Kanekar for helpful discussions.

1. Bloembergen, N. and Rowland, T. J., *Acta Met.*, 1953, **1**, 731.
2. Knight, W. D., Berger, A. G. and Heine, V., *Annals of Phys.*, 1959, **8**, 173.
3. Kimai, I. and Bloembergen, N., *J. Phys. Chem. Solids*, 1960, **13**, 257.
4. Seymour, E. F. W., Styles, G. A. and Taylor, B., *Compte rendu de la Colloque Ampère*, 1962, p. 612.
5. — and —, *Proc. Phys. Soc. (Lond.)*, 1966, **87**, 473.
6. Flynn, C. P. and Seymour, E. F. W., *Ibid.*, 1959, **73**, 945; *Ibid.*, 1960, **76**, 301.

MODE OF CULTURE AND GROWTH OF EXCISED ROOTS OF *PHASEOLUS AUREUS* ROXB., IN A SYNTHETIC MEDIUM

M. K. SUBRAMANIAM, S. ROYAN-SUBRAMANIAM,* S. SUBRAMANYAM AND G. MEENAKSHI

Cytogenetics Laboratory, Department of Biochemistry, Indian Institute of Science, Bangalore-12

EXCISED roots cultured under standardized conditions in synthetic media would form ideal material for screening the action of various chemicals on chromosomes. To do this, it is necessary to have accurate information that the meristematic cells continue to divide normally for a period of days in cultured excised roots. The seeds of green gram, *Phaseolus aureus* Roxb., could be germinated very easily. Some information is available on the chromosomes of the meristematic cells of the seedlings of this form.¹ Attempts were, therefore, made to culture its root-tips in a synthetic medium.

Generally, excised roots are cultured in liquid or solid media, in flasks or petri dishes. The analyses of their relative merits^{2,3} suggest that each laboratory would have to determine experimentally the optimal conditions for growth, especially when handling roots of species not cultured before.³ The utility of growing roots as stab and slant cultures in test-tubes was, therefore, explored. In a stab culture the root grows into the medium while in a slant it grows on the surface of the medium.

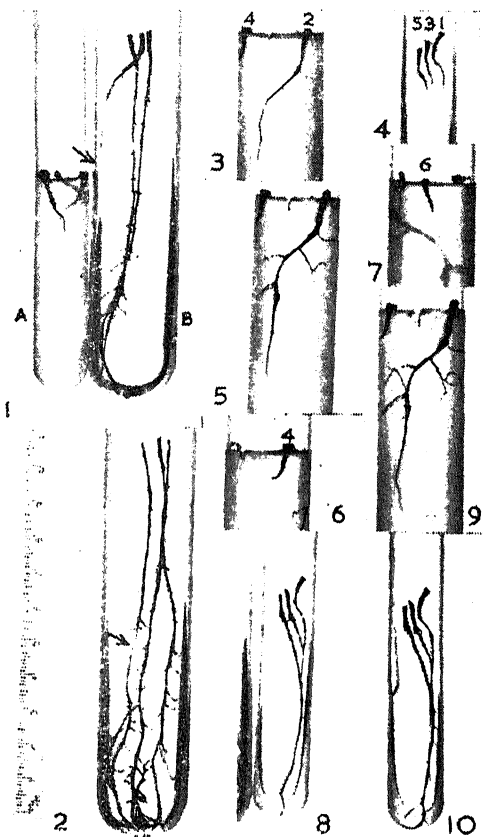
The sterilization and germination of the seeds—a commercial variety—were carried out in 100 ml. conical flasks. The seeds rinsed in 95%

ethyl alcohol were treated with a 0.1% solution of mercuric chloride for 5 min. and then with a fungicide (ethanol 50 ml., thymol 2 gm., glycerol 5 ml., made up to 100 ml. with distilled water) for 10 min. They were then washed in repeated changes of sterile distilled water. The seeds were soaked for 3-4 hours in the last change of distilled water and then allowed to germinate in a thin film of water beneath moist filter-paper strips. Twenty-four hours after germination, 4-6 mm. lengths of the root-tips were excised and grown as stab or slant cultures in a medium⁴ having the following composition: Na_2SO_4 200 mg., $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$ 737 mg., $\text{Ca}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$ 286.5 mg., KNO_3 80 mg., KCl 65 mg., $\text{NaH}_2\text{PO}_4 \cdot 2\text{H}_2\text{O}$ 19 mg., $\text{MnSO}_4 \cdot \text{H}_2\text{O}$ 5 mg., $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$ 2.672 mg., H_3BO_3 1.5 mg., KI 0.75 mg., MoO_3 0.0017 mg., $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ 0.013 mg., Sucrose 20 gm., Fe^{+2} -EDTA 10 ml., Glycine 3 mg., Nicotinic acid 0.5 mg., Thiamine hydrochloride 0.1 mg., Pyridoxine hydrochloride 0.1 mg., Agar 6 gm., water to 1 litre and adjusted to pH 4.0. The sterilization of the glassware was at 20 lb. for 1 hr., and the medium at 15 lb. for 20 minutes.

Photo 1 (A and B) illustrates the roots grown for 14 days as stab and slant cultures. The three roots in the stab culture (Photo 1A) showed no uniformity in growth. They had

*Scientists' Pool, C.S.I.R.

also no lateral roots. During the same period, the roots growing on slants were not only longer but had also produced secondaries and tertiaries (Photo 1B). In some slants, the tips of the roots had a tendency sometimes to curve and get lifted from the surface of the medium. When this happened, the region of growth out of contact with the medium was relatively thinner (arrows in Photos 1 and 2). When the growing tip came in contact with the medium again then the root resumed its normal rate of growth.



PHOTOS 1-10. Photo 1 (A and B). 14-day growth in a stab and a slant. Note the difference. Photo 2. 19-day growth on a slant. Arrow indicates the region of growth out of contact with the medium. Photo 3. 11-day stab culture. Three of the roots (1, 3 and 5) from this tube had been transferred to a slant on the 9th day. Photo 4. 2-day growth of the roots (1, 3 and 5) transferred to the slant. Photos 5-7. 23-day growth of the roots in the original stab. Photo 8. 14-day growth of roots on the slant. Photo 9. 29-day growth of root 2 in the stab. Photo 10. 20-day growth of roots 1, 3 and 5 on the slant.

To test whether the limiting factor is the availability of oxygen, an attempt was made to grow the roots as stab cultures and then transfer them to the surface of slants. When six roots were inoculated into the agar medium

only two exhibited a faster rate of growth (Table I).

TABLE I

Root No.	Initial Inoculum	Total length on the 6th day
1	4 mm.	16 mm.
2	4 mm.	23 mm.
3	4.5 mm.	9 mm.
4	6 mm.	6.5 mm.
5	6 mm.	7.5 mm.
6	5 mm.	8 mm.

Three of the roots, 1, 3 and 5 measuring 19 mm., 12 mm. and 12 mm. respectively on the 9th day were transferred from the stab to a slant. Photo 3 is of the roots 2 and 4 (root 6 is out of focus) in the original stab culture, while Photo 4 is that of roots 1, 3 and 5, two days after transfer to the slant. Apparently, the roots transferred to the slant had not grown much during the two days. But after an initial lag phase, they began to grow faster than the roots in the stab culture. Photos 5, 6 and 7 illustrate the roots 2, 4 and 6 in the original stab culture on the 23rd day. Root 2 alone had produced secondaries and tertiaries. Roots 4 and 6 on the other hand had grown very little (Photos 6 and 7). On the same day, roots 1, 3 and 5 (Photo 8) which had been on the slant for only 14 days (9 days in the stab and 4 days in the slant) exhibited vigorous growth. At the end of 29 days, two of the roots, 4 and 6, remained stunted in growth in the stab (Photo 9) while all the roots on the slant (9 days in the stab and 20 days on the slant) were still growing actively (Photo 10).

Excised roots of *Phaseolus aureus* grow better on slants than in stabs. Not only do all the roots grow on slants, but they produce also secondaries and tertiaries. Very few of the excised roots continue to grow in stabs. There is no uniformity in growth or lateral root formation in stab cultures. The fact that only some roots are capable of growth in stab cultures raises the question whether this is due to a genetic difference among the roots inoculated.

We are thankful to the Indian Institute of Science, Bangalore and the Council of Scientific and Industrial Research, New Delhi, for their encouragement.

1. Subramaniam, M. K. and Royan, S., *Curr. Sci.*, 1960, 29, 186.
2. Bonner, J. and Addicott, F., *Bot. Gaz.*, 1937, 99, 144.
3. Butcher, D. N. and Street, H. E., *Bot. Rev.*, 1964, 30, 513.
4. Antony, A., Parikh, L. J. and Ramakrishnan, C. V., *Tissue Culture*, Ed. C. V. Ramakrishnan, W. Junk, The Hague, 1935.

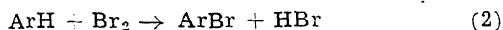
LETTERS TO THE EDITOR

THE KINETICS OF THE BROMINATION OF AROMATIC COMPOUNDS—PART III

In the previous parts^{1,2} it was shown that the overall reaction between bromine and an aromatic compound was of the third order in a solvent such as dry acetic acid. Since the order with respect to bromine was found to be two, the rate of disappearance of bromine can be expressed by the equation

$$-\frac{d[\text{Br}_2]}{dt} = k_3 [\text{ArH}] [\text{Br}_2]^2 \quad (1)$$

where ArH represents the aromatic compound. However, it is known that the substitution of bromine in the aromatic nucleus takes place according to the simple equation



This equation and its stoichiometry (1:1) were assumed by us, like the other workers, in applying the integrated rate expressions in the previous parts.^{1,2} It has also been reported³ that, at low concentrations, the order of the reaction becomes two. In view of this, we have now verified whether a second-order process is occurring along with the observed third-order reaction.

If second and third order reactions are occurring simultaneously, the overall rate of disappearance of bromine can be expressed as follows:

$$-\frac{d[\text{Br}_2]}{dt} = k_2 [\text{ArH}] [\text{Br}_2] + k_3 [\text{ArH}] [\text{Br}_2]^2 \quad (3)$$

Using the usual subscript to denote initial concentrations and initial rates, equation (3) can be written in the form

$$\frac{(-d[\text{Br}_2]/dt)_0}{[\text{ArH}]_0 [\text{Br}_2]_0} = k_2 + k_3 [\text{Br}_2]_0 \quad (4)$$

In Fig. 1, the lefthand expression in equation (4) has been plotted against $[\text{Br}_2]_0$ for two different substrates (The initial rates were obtained from the usual concentration-time curves for the disappearance of bromine in four different runs). The plots are linear and pass through the origin (i.e., $k_2 = 0$), showing thereby that the second-order term in equation (3) is absent. From the slopes of the straight lines A and B, the values of k_3 were found to be 0.167 and 75.0 M⁻² sec.⁻¹, respectively. These are in good agreement with the values 0.163 and 80.0 M⁻² sec.⁻¹ (to be published elsewhere)

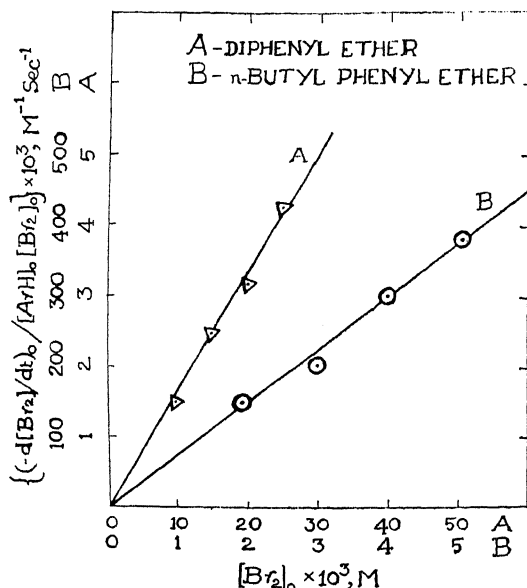


FIG. 1. Plots to test equation (4). A— $[\text{ArH}]_0 = 2 \times 10^{-1} \text{ M}$; $[\text{Br}_2]_0$ varied from 1.00×10^{-2} to $2.53 \times 10^{-2} \text{ M}$. B— $[\text{ArH}]_0 = 5 \times 10^{-2} \text{ M}$; $[\text{Br}_2]_0$ varied from 1.94×10^{-3} to $5.03 \times 10^{-3} \text{ M}$. Temp. 30°C; Solvent: Acetic acid.

obtained by the method of integration adopted in the previous parts.^{1,2}

Physical Chemistry Dept.,
University of Madras,
Madras-25, May 4, 1966.

K. V. SESHADRI.
R. GANESAN.

1. Seshadri, K. V. and Ganesan, R., *Curr. Sci.*, 1964, **33**, 366.
2. — and —, *Ibid.*, 1965, **34**, 429.
3. Robertson, P. W., De Ia Mare, P. B. D., and Johnston, W. T. G., *J. Chem. Soc.*, 1943, p. 276.

QUINOLINE AND ISOQUINOLINE COMPLEXES OF SILVER (I)

SEVERAL two-co-ordinated linear complexes like $[\text{Ag}(\text{NH}_3)_2]^+$, $[\text{Ag}(\text{CN})_2]^-$ were known.¹ In addition, silver(I) forms complexes where the co-ordination number is apparently three.^{2,3} In this communication, two compounds, viz., nitrato bis-quinoline (isoquinoline) silver (I) complexes are reported and these are two more examples for this unusual co-ordination number three. In addition, two compounds having the formula $[\text{AgL}_2]\text{ClO}_4$ where L = quinoline or isoquinoline are also characterised.

TABLE I

Compound	Formula	M.P. (° C.)	% Silver		Λ_m in acetone (mhos)
			Found	Reqd.	
1. Nitrate bis-quinoline silver (I) ..	[AgQ ₂ NO ₃]	118	25.5	25.2	35.9
2. Nitrate bis-isoquinoline silver (I) ..	[AgIQ ₂ NO ₃]	165	24.6	25.2	38.1
3. Bis-quinoline silver (I) perchlorate ..	[AgQ ₂]ClO ₄	185	23.5	23.1	145.2
4. Bis-isoquinoline silver (I) perchlorate	[AgIQ ₂]ClO ₄	215	22.0	23.1	154.5

Silver perchlorate was prepared by treating silver oxide with insufficient amount of perchloric acid. Concentrated solution of silver perchlorate was treated with an aliquot amount of the ligand. White crystalline compounds separated out immediately. Similar behaviour was noticed when aqueous silver nitrate solution was treated with the ligand. The compounds were filtered, washed and dried *in vacuo*. The nitrate compounds are appreciably soluble in chloroform, acetone, nitrobenzene and sparingly soluble in ethanol whereas the perchlorate compounds are fairly soluble in ethanol and acetone but sparingly soluble in chloroform. Silver was estimated in the complexes as halide. Magnetic susceptibility measurements on solid specimens indicated that all the compounds are diamagnetic. Conductance measurements were made using a Toshniwal conductivity bridge type CL 0102. The relevant data are recorded in Table I.

The nitrate bis-quinoline (isoquinoline) silver (I) complexes are diamagnetic, non-electrolytic complexes. Univalent silver has a completely filled d^{10} non-bonding shell and hence a diamagnetic, three-co-ordinated complex is possible involving the use of Sp^2 bonding orbitals. The molar conductance values in acetone medium for 1 : 1 electrolytes lie in the range 150–200 mhos and the low values exhibited by these compounds indicate that they are essentially non-electrolytes. Hence, nitrate group also is co-ordinated to the metal. To obtain further evidence, the absorption in the infra-red region was studied using Unicam SP-200 Spectrophotometer and the I.R. Spectrum of Ag(Quinoline)₂NO₃ contains, in addition to the bands due to quinoline, bands at 790 (sh), 840 (s), 1015 (s), 1240 (s), 1480 (sh) cm^{-1} . Recently it was shown⁴ that co-ordinated nitrate groups give rise to bands in the regions 781–800, 970–1034, 1253–1290 and 1481–1531 cm^{-1} . Thus, the complexes [AgL₂NO₃] clearly exhibit bands due to co-ordinated nitrate.

The perchlorate complexes are more usually two-co-ordinated complexes of silver(I). Perchlorate ion cannot co-ordinate with the metal and hence remains outside the co-ordination

sphere as an anion. The molar conductance values are round about 150 mhos and hence the compounds are 1 : 1 electrolytes as expected.

The authors thank the Ministry of Education, Government of India, for the award of a Research Training Scholarship to one of them (R. N. P.).

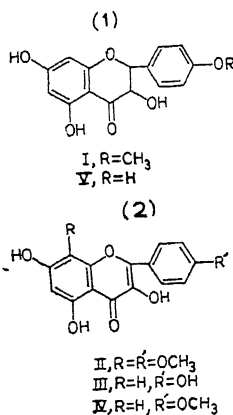
Dept. of Chemistry, R. N. PATEL.
Regional Engg. College, D. V. RAMANA RAO.
Rourkela-8 (Orissa), March 3, 1966.

1. Bailar, J. C., *Chemistry of Co-ordination Compounds*, Reinhold Publishing Co., 1956 Ed., p. 383.
2. Ahrland, S. and Chatt, J., *Chem. and Ind.*, 1955, p. 96.
3. Cass, R. C., Coates, G. E. and Hayter, R. G., *Ibid.*, 1954, p. 1485.
4. Cotton, F. A., Goodgame, D. M. L. and Soderberg, R. H., *Inorg. Chem.*, 1963, 2, 1162.

MINOR FLAVONOID COMPONENTS OF THE HEARTWOOD OF *PRUNUS* *DOMESTICA*

IN an earlier publication¹ were reported the isolation and characterisation of dihydrokæmpferide (I), prudomestin (II) and kæmpferol (III) from the heartwood of *Prunus domestica*. Besides them, tail fractions of the ether extract were considered to contain dihydroflavonols (e.g., 'substance E'). Since, these exhibited similar characteristics they were mixed together and subjected to preparative paper chromatography (Whatman No. 1 paper, 50% acetic acid as solvent). Of the six bands that could be observed, bands 1, 5 and 6 (in the order of increasing R_f) yielded components in minor quantities insufficient for characterisation. Band 2 yielded kæmpferol after crystallisation from alcohol. Band 3 yielded a brownish-yellow substance which after crystallisation from ethylacetate-petroleum ether was found to agree with kæmpferide (IV) in all respects. From band 4, a brownish solid was obtained. It gave marked colour reactions of dihydroflavonols^{2,3} and had u.v. maximum at 292 $m\mu$. It crystallised from ethylacetate-petroleum ether as colourless prisms but melted over a range. Colour reaction with concentrated nitric acid (wine red colour) and paper chromatography

suggested that it might contain aromadendrin (V). The product obtained on dehydrogenation of this substance by iodine-potassium acetate method⁴ did not melt sharply; paper chromatography showed the dehydrogenation product to be a mixture of two flavonols separable by preparative paper chromatography and they were identified as k  mpferol (major component) and k  mpferide by comparison with authentic samples. It was therefore concluded that band-4 actually contained a mixture of two dihydroflavonols, viz., aromadendrin (V) and dihydrok  mpferide (I).



Thus, it is clear that the heartwood of *P. domestica* contains related flavonols and dihydroflavonols, viz., k  mpferol and dihydrok  mpferol, k  mpferide and dihydrok  mpferide though dihydroprudomestin has not so far been detected. This kind of association has been known before in a number of cases some of which have already been listed.⁵ Commonly the accompanying leucoanthocyanidin is also related to the dihydroflavonol but in this particular wood this relationship does not seem to exist. The leucoanthocyanidin is somewhat complex and is still under study.

Department of Chemistry, G. R. NAGARAJAN.
University of Delhi, T. R. SESHADRI.
Delhi-7, April 29, 1966.

1. Nagarajan, G. R. and Seshadri, T. R., *Phytochemistry*, 1964, 3, 477.
2. Pew, John, C., *J. Amer. Chem. Soc.*, 1948, 70, 3031.
Pacheco, H. and Chanderson, M., *Compt. rend.*, 1956, 242, 1621.
3. Krishnamurthy, H. G., Krishnamoorthy, V. and Seshadri, T. R., *Phytochemistry*, 1963, 2, 47.
4. Laumas, K. R. and Seshadri, T. R., *Proc. Indian Acad. Sci.*, 1959, 49 A, 47.
5. Seshadri, T. R., *Les Heterocycles oxyg  n  s*, Colloques Internationaux du centre National la Recherche Scientifique, 1955, p. 71.

STRUCTURE OF MUNDULEA LACTONE ISOLATED FROM THE ROOTS OF MANDULEA SUBEROSA

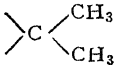
In a previous communication from the laboratory,¹ the isolation of two crystalline compounds from the root bark of *Mundulea suberosa* obtained from Coimbatore and some of the characteristics of the components isolated were described. Recently, when the root bark obtained from the same place has been re-examined, in addition to the two crystalline compounds reported earlier, another colourless substance, melting at 192  , has been isolated. This substance has been found to be identical with munetone reported earlier by Dutta.² The phenolic compound, melting at 155-57  , has now been found to be identical in all respects, with an authentic sample of sericetin,³ kindly supplied by Prof. W. D. Ollis.

The major yellow crystalline compound, melting at 104  , reported earlier to be an $\alpha : \beta$ unsaturated lactone is now designated as mundulea lactone and examined in greater detail. Its molecular formula is now revised as C₁₉H₂₀O₃ on the basis of mass spectral data (Mol. Wt. 296). On hydrogenation, mundulea lactone absorbed three moles of hydrogen. The substance did not give any reaction for free hydroxyl group or a reactive carbonyl group with the usual reagents. On hydrolysis with 5% alcoholic potash the lactone gave an unsaturated acid melting at 128-29  , now identified as cinnamic acid. On oxidation with hydrogen peroxide it gave benzoic acid. The earlier report on the absence of coumarin ring system is now confirmed. On demethylation with AlCl₃ in benzene the substance gave a compound soluble in sodium bicarbonate indicating acidic properties, which appear to be due to an enolic hydroxyl group rather than a carboxyl group.

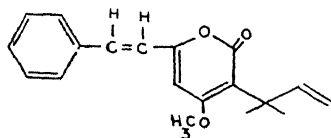
The ultra-violet absorption spectrum of mundulea lactone showed λ_{max} (in m μ) 230 (log ϵ 4.42), 265 (4.42), 310 (4.25) and 360 (4.47) and these data closely resemble the u.v. data of some of the naturally occurring styryl- α -pyrones⁴ (Methysticin, yangonin and dehydrokawain isolated earlier from Piper methysticin Forst). The infra-red absorption spectrum of the substance exhibited two absorptions at 1725 cm.⁻¹ and 1647 cm.⁻¹ confirming the presence of $\alpha : \beta$ -unsaturated lactone ring in the compound.

The nuclear magnetic resonance spectrum of the lactone gave a total proton count of (20) and showed the τ values as given in Table I.

TABLE I
N.M.R. data of mundulea lactone

		-OCH ₃	Vinyl protons	Protons of ethylenic double bond	Aromatic protons
τ Values	8.49 (6 H) Singlet	6.15 (3 H) Singlet	5.13 (1 H) and 5.07 (1 H) 2.48 (1 H)	3.76 (1 H) and 3.43 (1 H) doublet (J = 16 c/s transcoupling)	2.4 to 2.7 (5 H) multiplet 2.4 (1 H) doublet

Based on the spectral data and the degradative evidence, the lactone has been tentatively assigned the structure, 3- α , α -dimethylallyl-4-methoxy-6-styryl- α -pyrone(I).



(I)

The presence of an isoflavone munetone, flavonol sericetin and styryl- α -pyrone, mundulea lactone in the same plant is of biogenetic interest. The authors express gratitude to Prof. W. D. Ollis (University of Bristol) for supplying a sample of sericetin, N.M.R. spectrum of mundulea lactone and helpful discussions.

Chemistry Department, V. R. LALITHA.
Osmania University, G. SRIMANNARAYANA.
Hyderabad, May 4, 1966. N. V. SUBBA RAO.

1. Rao, K. B. and Rao, N. V. S., *J. Sci. Industr. Res.*, 1958, 17 B, 384.
2. Dutta, N., *J. Indian Chem. Soc.*, 1956, 33, 713.
3. Burrows, B. F., Ollis, W. D. and Jackman, L. M., *Proc. Chem. Soc.*, 1960, p. 177.
4. Wiley, B. H., Jarboc, C. H. and Ellert, H. G., *J. Amer. Chem. Soc.*, 1955, 77, 5102.

FLUORSPAR OCCURRENCE NEAR KOTESHWAR IN BARWAHA TEHSIL, DHAR FORESTS, M.P.

DURING exploration for uranium, the authors found fluorite-bearing felsite dykes between west of Chiktimondri and Koteswar a distance of some three miles (Toposheet Nos. 55 B/3 and 4). The situation of these rocks immediately north of the Narmada rift and the presence of nepheline syenites around Koteswar distinctly intrusive into the Vindhyan which were domed up in the post-Trappean diastrophism, bear close resemblance to a similar occurrence of fluorite in Amba Dongar reported earlier by

Sukheswala and Udas (1964) of which this may be regarded as another example.

The area falls between latitudes 22° 14' 30" and 22° 17' 30" and longitudes 76° 4' to 76° 6' north of Narmada river in the Dhar forest in Barwaha Tehsil about 4 miles east of Barwaha Town.

North-west of this area, near Londi, the Traps which gently dip southwards and overlies Vindhyan, have been faulted, the southern upthrow resulting in the exposures of the Vindhyan at much higher elevations than their general level in the terrain, as for instance near Kundi.

The village Chiktimondri is situated in a depression caused by collapse of the central portion of the domed-up Vindhyan. As a result of this the Traps above the Vindhyan are preserved in the central depression. The steep scarps of the Vindhyan sandstones around the central depression show quaquaversal dips. The phyllites of Vindhyan (?) age underlying the Traps and sandstones are folded into close folds and intruded by felsite dykes which border the central depression. Syenitic rocks together with felsite dykes are observed along the inner side of the western rim of the dome. The southern inner rim of the dome shows exposures of calcitic rocks and calcitic breccias rich in oxides and carbonates of manganese and iron. The nullahs along the inner periphery of the dome are covered by travertines.

FLUORSPAR

The felsite dykes trending NNW-SSE from near the deserted village Bhadlipura to Koteswar occur over a distance of three miles. They have been found to be somewhat radioactive and contain numerous veins of calcite, pyrite and quartz. Fluorite occurs as veins as well as coating on mineral grains in the felsites. The felsite dykes particularly rich in fluorite are observed at two localities: (1) immediately south-east of Koteswar the felsites cut across both the banks of the Narmada

where the dyke is 660 feet long and 25 feet wide; and (2) 650 feet long and 10 feet wide dyke north of Surtipura village where its best exposure is seen on a mound SE of Δ 972.

Fluorite, forming cubic and octahedral crystals and white, violet and dark violet in colour, occurs as veins which follow cracks and joints in felsites and vary from a fraction of an inch to one inch in width. In wider veins the size of fluor spar crystals is upto half centimetre. Thin sections of felsites reveal disseminations of fluorite throughout the rock. A thin coating of fluorite, deep violet in colour, is very often observed along freshly broken surfaces of the rock.

Because of the abundance of fluorite in the felsite dykes the occurrence appears to be promising for exploitation of the mineral.

SYENITES

Radial to the dome and along the southwestern portion of its outer periphery are exposures of nepheline syenites which contain feldspars, nepheline and pyroxenes as prominent minerals. Quartz is absent. The dykes of this rock have thicknesses of 30 to 40 feet and are distinctly intrusive in the domed-up Vindhyan sandstones.

CONCLUSIONS

Syenites of post-Trappean age were predicted along the Narmada rift (1964). This area has shown the presence of syenites intrusive into Vindhyan subjected to post-Trappean diastrophic movements in a continental setting, in close proximity of the Narmada rift. Fluorite mineralisation of Amba Dongar alkalic complex is also located almost immediately north of the Narmada rift. The authors wish to put on record a similar occurrence of a fluorite deposit in Barwaha Tehsil, Khargaon District, Madhya Pradesh.

The authors are indebted to Shri K. K. Dar and Dr. G. R. Udas for valuable suggestions and guidance.

Atomic Minerals Division,
Dept. of Atomic Energy,
New Delhi-5, March 16, 1966.

D. S. SHARMA.
V. P. RODE.

ON THE OCCURRENCE OF KARHARBARI PLANT FOSSILS IN DALTONGANJ AND JAINTI COALFIELDS, BIHAR

THE fossil flora of the Karharbari stage was first described by Feistmantel (1879) from the type area of the Giridih coalfield, where the fossiliferous beds are known to contain an abundance of *Gangamopteris* and *Næggerathiopsis* together with the characteristic *Buriadia* and *Gondwanidium*. That these elements characterise the Karharbari stage is now fully supported by the exhaustive studies recently carried out by Maithy (1965, a, b, c and d) on the Karharbari flora of the type area.

In several other Lower Gondwana basins also, especially the Daltonganj and the Jainti coalfields, there have been reports of fossil plants in beds which lie between the Talchirs and the Barakars.

The authors visited the Daltonganj and the Jainti coalfields during the year 1965-66 and were able to collect interesting evidence of Karharbari plant assemblages which throw light on the age of the coal-bearing formations of these areas. In the Daltonganj coalfield (Palamau District, Bihar) the coal-bearing rocks have been assigned to the Barakars.

However, Feistmantel (1886) believed them to belong to the Karharbaris on the basis of plant fossils which came from the Singra and Rajhara area. From the Rajhara Colliery, the authors have now been able to collect sufficiently rich plant fossil material which contains, among other things, Equisetalean stems, *Phyllothea*, *Gangamopteris*, *Glossopteris*, *Næggerathiopsis*, *Buriadia*, *Samaropsis* and *Cordaicarpus*. In this assemblage, the occurrence of *Gangamopteris*, *Næggerathiopsis* and *Buriadia* is specially noteworthy as they are the typical elements of the Karharbari stage.

In the Jainti coalfield also (Hazaribagh District, Bihar) the coal-bearing beds above the Talchirs have been generally assigned to the Barakars. Puri (1953), however, first reported the occurrence of Karharbari plant fossils in this area from certain shales exposed in a nala cutting near Misra village. The present authors also had the good opportunity to collect a rich plant assemblage from this locality. This flora contains, among other things, *Gangamopteris* (abundant), *Glossopteris*, *Næggerathiopsis*, *Schizoneura*, *Phyllothea*, *Samaropsis*, *Cordaicarpus*, *Buriadia* and *Gondwanidium*.

In view of the presence of the characteristic Karharbari elements in the flora found near

1. Dar, K. K., *Jour. Geol. Soc., Ind.*, 1964, 5.
2. Roy Chaudhary, M. K. and Sastry, V. V., *Rec. G.S.I.*, 1958, 85, 4.
3. Sakheswala, R. N. and Udas, G. R., *XXI Int. Geol. Cong.*, 1964,

Misra village in the Jainti coalfield and in the Rajhara Colliery in the Daltonganj coalfield it would appear that they are homotaxially equivalent with the Karharbari stage of the Giridih coalfield. In the light of the present findings it would be worthwhile looking for similar plant fossil evidences in other areas where the Karharbari stage may be present.

Birbal Sahni Institute of K. M. LELE.
Palaeobotany, P. K. MAITHY.
Lucknow. February 19, 1966.

1. Feistmantel O., *Paleont. indica*, 1879, 3 (1), 1.
2. —, *Ibid.*, 1886, 4 (2), 1.
3. Maithy, P. K., *Paleobotanist*, 1965 a, 13 (1), 45.
4. —, *Ibid.*, 1965 b, 13 (1), 94.
5. —, *Ibid.*, 1965 c, 13 (3), 239.
6. —, *Ibid.*, 1965 d, 13 (3), 291.
7. Puri, S. N., *Proc. 44th Indian Sci. Cong.*, 1953, p. 169.

PSEUDOBANCH IN *TILAPIA* *MOSSAMBICA* (PETERS)

So far as I am aware, a pseudobranch has not been described in the family Cichlidæ. Day,¹ in fact, considers the absence of the pseudobranch as a diagnostic character of this family. My investigations have, however, revealed that a well-developed pseudobranch exists in *Tilapia* as well as in *Etioplos*, the only other member of the Cichlidæ represented in India. The observations recorded below are based on the study of the adult as well as larval forms of both these fishes.

In fresh specimens of adult *Tilapia*, the two pseudobranchs are visible as reddish oval patches on the dorsolateral sides of the oral chamber. They can be more clearly examined after the removal of the epithelial lining of the oral chamber covering them. The pseudobranchs present a dull whitish appearance in formalin-preserved specimens. In *Etioplos*, they occupy a similar position and present the same morphological picture as in *Tilapia*. As a matter of fact, the similarity in structure and the very existence of the pseudobranchs in both *Tilapia* and *Etioplos* further justifies their inclusion in the same family.

The pseudobranch in *Tilapia* makes its appearance rather early, i.e., when the embryo is only 5 mm. long. Already in a 10 mm. long embryo, in a transverse section, the pseudobranch can be discerned as a conspicuous organ located towards the dorsolateral side of the oral chamber and median to the upper part of the hyomandibular cartilage (Fig. 1). The structure of the pseudobranch is different from that of a functional gill in that there are no free gill

lamellæ, although there does appear a similarity between the cells of the pseudobranch and those of the gills. The entire organ appears as compact structure sunk below the oral lining and traversed by numerous blood capillaries through which the blood from the afferent pseudobranchial artery passes into the efferent pseudobranchial artery. The pseudobranch is constituted of rows of cells arranged in regular columns, each such row being ensheathed in connective tissue. There is a well-defined space between two adjacent columns of cells. The exact nature of cells, their resemblances with cells found in functional gills and the fact whether they are of endocrinal function, as contemplated about the pseudobranch in higher teleostomes (Goodrich),² are presently being investigated.

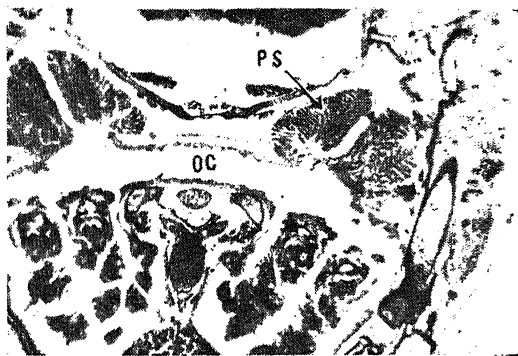


FIG. 1. Photomicrograph of T.S. of a 10 mm. larva of *Tilapia* passing through the region of pseudobranchs. PS—pseudobranch; OC—oral chamber.

The blood supply to the pseudobranch in *Tilapia* is maintained even in the adult condition both by the primary and secondary afferent vessels as in *Gadus*.⁶ But *Tilapia* is different from *Gadus* since the secondary afferent pseudobranchial artery is only an extension of the orbital artery and not a branch of the internal carotid as in the case of *Gadus*. *Tilapia* thus represents a unique condition. The structure described is a pseudobranch because it receives aerated blood from the carotid artery.

The blood from the pseudobranch is collected by a large efferent pseudobranchial artery. It runs forward from the antero-median corner of the pseudobranch for a short distance and enters the orbital cavity. Further forward, the two efferent pseudobranchial arteries establish a cross-connection between them, which traverses the ventral myodomic compartment of the posterior myodome in this region. Beyond this connection, each artery runs across

the orbit as the ophthalmica magna artery to supply the choroid gland of the eye.

As in *Mastacembelus armatus*,⁷ the pseudo-branch in *Tilapia* is supplied by a branch of the ninth cranial nerve and this indicates that it is hyoidean pseudobranch and not a spiracular one.

The author wishes to express his gratitude to Professor D. S. Srivastava under whose guidance this work was carried out.

Department of Zoology, C. B. MENON.
University of Rajasthan,
Maharaja's College,
Jaipur (Rajasthan), April 26, 1966.

1. Day, F., *Fauna of British India*, 1889, 2.
2. Goodrich, E. S., *Studies on the Structure and Development of Vertebrates*, Macmillan & Co. Ltd., London, 1930.
3. De Beer, G. R., *Development of Vertebrate Skull*, Oxford, 1937.
4. Bhargava, H. N., *Curr. Sci.*, 1953, 22, 343.

KARYOMORPHOLOGICAL FACTORS FAVOURING THE INCIDENCE OF CHROMOSOMAL INTERCHANGES

Chrysanthemum carinatum Schousb. and *Cosmos bipinnatus* Cav. are winter garden annuals of the family Compositae. Both these species are diploids having respectively 18 and 24 as their somatic chromosome numbers. It was observed earlier during the course of an irradiation programme that the success achieved in experimental induction and recovery of chromosomal interchanges, and in synthesising a number of such interchanges in individual plants through the process of hybridization, in *Ch. carinatum*¹ was in marked contrast to the failure of this technique in *Co. bipinnatus*. Karyomorphological studies were undertaken to find out if chromosomal characteristics had any bearing upon the observed differential response of these two species to induced chromosomal rearrangements.

For a comparative study of the karyotypes, dividing chromosomes in the root-tip cells were obtained. Root-tips were fixed in acetic-alcohol and subsequently stained by the Feulgen's technique. Measurements of chromosomes were made from camera lucida drawings of metaphase plates from slides prepared in a strictly comparable manner. Most of the 18 chromosomes of *Ch. carinatum* were found to have median primary constrictions whereas most of the 24 chromosomes of *Co. bipinnatus* were of the submedian type. This difference in karyomorphology of the two species could also be inferred from observations on the types of

configurations formed by their bivalents at metaphase-I. Homologous chromosomes of *Ch. carinatum* formed mostly ring bivalents while those of *Co. bipinnatus* formed predominantly rod bivalents. Total chromatin length, based on observations on ten metaphase plates, was found to be $132.26 \pm 4.78 \mu$ in case of *Ch. carinatum* and $60.53 \pm 6.32 \mu$ in *Co. bipinnatus*. It may also be mentioned that the presence of well-marked heterochromatic regions near the centromeres of most of the chromosomes appeared to be a characteristic feature of the *Chrysanthemum* material.

It should be recognised that response to initial induction of chromosomal interchanges is independent of the potential survival value which the interchanges may come to have. Different number of interchanges in irradiation experiments may arise from different degrees of initial chromosome damage, from varying amounts of reunions of broken ends, or from a combination of both these factors. Genetic control of radiosensitivity following acute irradiation with X- or gamma-rays has often been reported.²⁻⁴ A similar influence of genotype on the frequency of induced chromosomal aberrations has been implied in lily,⁵ peas⁶ and rye.⁷ The present observations on several varieties of the two species under study did not indicate any such genotypic control. Apart from their physiological characteristics, the differential response of these two species to the radiation-induced chromosomal interchanges appears to be conditioned by certain chromosomal features. Firstly, the chromosomes of *Chrysanthemum* are relatively much longer than those of *Cosmos* and, secondly, all the chromosomes of *Chrysanthemum* have median or nearly median primary constrictions while a majority of the chromosomes of the *Cosmos* complement are of the submedian type. Thus, the better response of *Ch. carinatum* appears to be, in part at least, a function of its highly balanced and symmetrical karyotype. Cleland indicated a similar conclusion from his studies on *Oenothera*.⁸ It is noteworthy that the exchanged segments in *Ch. carinatum* were mostly of equal length and nearly whole chromosome arms were interchanged.⁹ Probably, the observed heterochromatin blocks in this material lead to localized breakage.

A cytological survey of several populations of *Ch. carinatum* and *Co. bipinnatus* revealed that the former were characterised by the presence of naturally occurring interchanges whereas the latter were characteristically devoid of them. It is not implied, however, that all the species

with uniform chromosomes of appropriate size and structure may come to develop interchange-complexes. Obviously, these karyomorphological traits, together with certain meiotic characteristics (like disjunctional segregation of the interchanged chromosomes) not considered here, are merely permissive to the development of such systems. The fundamental requirement, however, is the heterozygote superiority of gene combinations ("super-genes")¹⁰ which the interchanges help to establish.

The author is grateful to Dr. H. K. Jain and Dr. M. S. Swaminathan for their advice.

Division of Botany, R. S. RANA.
Indian Agri. Res. Inst.,
New Delhi-12, July 12, 1965.

1. Rana, R. S., *Experientia*, 1964, **20**, 617.
2. Smith, L., *Amer. J. Bot.*, 1942, **29**, 189.
3. Grahm, D., *Proc. 2nd Intern. Conf. Peaceful Uses of Atomic Energy*, 1958, **22**, 394.
4. Davies, D. R., *Heredity*, 1962, **17**, 63.
5. Pershad, G. D. and Bowen, C. C., *J. Heredity*, 1961, **52**, 67.
6. Gelin, O., Ehrenberg, L. and Blixt, S., *Agr. Hort. Genet.*, 1958, **16**, 78.
7. Lawrence, C. W., *Radiation Bot.*, 1963, **3**, 89.
8. Cleland, R. E., *Proc. Intern. Genet. Symp.*, Tokyo and Kyoto, 1956, p. 5.
9. Rana, R. S., *Chromosoma*, 1965, **16**, 477.
10. Darlington, C. D. and Mather, K., *The Elements of Genetics*, Allen and Unwin, London, 1952.

TOLERANCE OF AN ANTICOAGULANT BY *RATTUS RATTUS*

LUND² had mentioned of the indication of some resistance seen by some rats to an anticoagulant rat poison. Since then W.H.O.³ has summarised this phenomenon at some more places.

In our field trials of zinc phosphide, shoxin and rodafarin (a locally available anticoagulant) in the hinterland it was observed that the last poison did not adequately reduce the rat numbers even though the trials were conducted for 12 days.

Rats were, therefore, fetched from two areas in the hinterland and were used in experiments along with local rats to find out their tolerance to the locally available anticoagulant.

The rats were kept under quarantine for one month and starved for 24 hours before they were given 0.0025%, 0.005% and 0.01% active ingredient Rodafarin in crushed cereals.

Table I gives the results of these experiments. Instructions received inform us of tolerance in a rat if it survives a dose of 0.005% of the active ingredient. The mean day of mortality in all the cases is after 6 days. The point of interest in these studies is that previous trials done on *R. rattus* of Bombay (Deoras)¹ indicated a mean day of mortality between 4-5 days by anticoagulants. Since then, some of these poisons have been used in the town of Bombay and now this mean has gone up. But Chanda and Nagpur are more than 600 miles from Bombay and no anticoagulant has ever been used there. The tolerance seen there seems to be a natural one and needs further such evidence from other quarters to call it a Natural Resistance. However, this is the first indication in India of such a phenomenon in rats.

I am thankful to the Institute for facilities, Messrs. Pest Control for Rodafarin and Mr. Chaturvedi for assistance.

TABLE I

The mortality in Rattus rattus to varying concentrations of Rodafarin at varying intervals

Regions from where rats collected for trials	Concentration	Number of rats kept for expt.	Number of rats died by hæmorrhage upto (dead/kept)			Total survival beyond 20th day	Death due to other cause
			5th day	10th day	20th day		
Bombay	0.0025	10	4/10	3/6	-/3	3	..
	0.0050	10	3/10	4/7	2/3	1	..
	0.0100	10	1/10	8/9	1/1	..	..
Chanda	0.0025	10	2/10	2/8	3/6	3	..
	0.0050	10	3/10	4/7	1/3	1	1
	0.0100	10	4/10	3/6	1/3	2	..
Nagpur	0.0050	4	1/4	1/3	2/2	..	..
	0.0100	4	1/4	2/3	1/1	..	..
Control	..	10	-/10	1/10	-/9	9	..
Total	..	78	19/78	28/59	11/31	19	1

Department of Entomology,
Haffkine Institute,
Bombay-12, March 21, 1966.

P. J. DEORAS.

1. Deoras, P. J., *Curr. Sci.*, 1965, **34** (11), 348.
2. Lund, M., *Nature*, 1964, 203 (4940), 778.
3. *World Health Organisation Chronicle*, 1966, **20**(1), 29.

A NEW LEAF-SPOT DISEASE OF SESAMUM

SESAMUM plants (*Sesamum orientale* L.) in cage house showed severe leaf-spots in September 1962. The disease appeared as small brown-coloured spots, which increased in size, changed to dark brown and assumed irregular shape, later coalescing. In severe cases midribs and petioles were also affected.

Transverse sections of the affected portions showed erumpent pycnidia with long necks. Isolations from the diseased portions also yielded the pycnidia producing fungus which has been identified as *Sphaeronema*. The fungus has been observed to be pathogenic on young plants, initial symptoms appearing after four days of inoculation and pycnidia developing thirteen days thereafter. The fungus appears to be a new species of *Sphaeronema* and is described below.

Sphaeronema sesami SP. NOVO. SEHGAL AND
DAFTARI

Hyphae septatae, compactae, pallide brunneae, 3.7-7.5 μ latae. Pycnidia rostrata, erumpentia, distincta, 50-243 \times 33-166 μ rostro inclusio, rostro vero 17-66 \times 10-17 μ , conidia hyalina, ovoidea vel ellipsoidea, 4.2-8.3 μ .

Parasiticum in follis et petiolis *Sesami orientalis*, 27-9-1962, legerunt S. P. Sehgal et L. N. Daftari at Kota in India, et typum posuerunt in herbario sectionis is pathologicae plantarum in Rajasthania, et Herb. I.M.I., Kew, (Subnumero 100417).

Hyphae septate, compact, light brown 3.7-7.5 μ wide, pycnidia rostrate, erumpent, separate, 50-243 \times 33-166 μ (length including neck), neck 17-66 \times 10-17 μ , conidia hyaline, ovoid to ellipsoid, 4.2-8.3 μ .

Parasitic on leaves and petioles of *Sesamum orientale* L. collected on 27-9-1962 by S. P. Sehgal and L. N. Daftari from Kota, India. The type specimen has been deposited in the Herbarium of the Plant Pathology Section, Rajasthan.

The authors are indebted to Dr. R. L. Mathur, Plant Pathologist, Rajasthan, Jaipur, for guidance, to Shri T. C. Kala, Director of Agriculture, Rajasthan, for facilities, to C.M.I.

for help in the identification of the fungus and to Rev. Father Dr. H. Santapau, Director of Botanical Survey of India, for Latin diagnosis.

Plant Pathology Section, S. P. SEHGAL.
Substation Kota, L. N. DAFTARI.
Rajasthan, November 30, 1964.

DISCOSIA POONENSIS SP. NOV., FROM INDIA

A SPECIES of *Discosia* with typical discoid pycnidium was collected by the writer on the hills of Law College, Poona, parasitizing the leaves of *Cassia nodosa* Ham., during the month of July 1961. The genus is represented in India by five species. The present species has been collected on a hitherto unreported host and was therefore compared with Indian species.

The comparative results showed that this species is distinct in all respects from the known species, but appeared closer to *D. hiptages* Tilak. A critical comparison, however, between these two species showed that Poona species has typically discoid pycnidia and uniformly septate conidia unlike *D. hiptages*, which possess globular pycnidia and conidia with a variable number of septa besides being collected on a hitherto unreported host.

It is therefore proposed to accommodate the Poona fungus as a new species with Latin diagnosis.

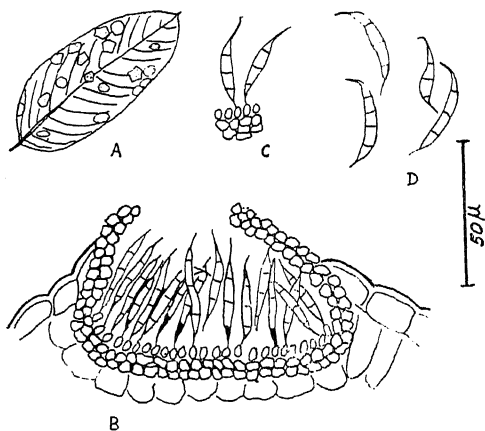


FIG. 1. A = Infected leaf. B = Pycnidium (Section). C = Conidiophores and Conidia. D = Conidia.

Discosia poonensis SPEC. NOV.

Infectionis maculae epiphyllae, dispersae, rubrobrunneae marginibus fuscus plus minusve circulares 3-8 mm. Pycnidia typice discoidea fusce brunnea vel nigra, dispersa, immersa in textus plantae hospitis ostiolo angusto, 63-126 \times 126-144 μ .

Conidiophori bulbosi, minuti, arcte dispositi in imo pycnidio. Conidia hyaline, 3-septata, cylindrica, paulum curvata, unica appendice ad utrumque apicem, $16.8-33.6 \times 3.2 \mu$.

In foliis viventibus *Cassia nodosa* Ham. ad Poona in India mense julio anni 1961, leg. dna I. K. Kalan.

The type is being deposited in Herb. Crypto. Indie Orientalia, New Delhi and Herbarium, C.M.I., Kew, England.

Grateful thanks are due to Prof. M. N. Kamat for guidance and to Director, National Botanic Gardens, Lucknow, for encouragement and facilities and to Rev. Fr. H. Santapau for Latin diagnosis of the species.

Mycology Laboratory, (Miss) I. K. KALANI.
National Botanic Gardens,
Lucknow (India), June 26, 1965.

1. Chona, B. L., Munjal, R. L. and Kapoor, J. N., *Indian Phytopath.*, 1957, **10**, 148.
2. Hasija, S. K., *Proc. Nat. Acad. Sci., India*, 1962, **32**, 413.
3. Lacy, R. C., *Indian Phytopath.*, 1958, **14**, 115.
4. Roy, R. Y., Dwivedi, R. S. and Shukla, M., *Proc. Nat. Acad. Sci., India* (Ann. Number), 1958, p. 66.
5. Tilak, S. T. and Viswanathan, T. S., *Curr. Sci.*, 1959, **28**, 252.

UNCINULA UDAIPURENSIS SP. NOV.
ON CORDIA OBLIGUA WILLD. VAR.
WALLICHII (G. DON) CLARKE

Cordia obligna Willd. var. *wallichii* (G. Don) Clarke is a wild small tree belonging to the family Boraginaceae. It is widely distributed from Western India to Coorg. A powdery mildew was collected on this plant from Sajjangarh near Udaipur, Rajasthan and identified as *Uncinula* sp. Perhaps there is no record of any *Uncinula* sp. on the host family and, therefore, it is proposed to assign the rank of a new species to the present fungus. A description of the same is presented here.

Uncinula udaipurensis Sp. Nov.

The mycelium is septate, epiphyllous, persistent, effused and covered over the entire upper surface of the leaves giving them a silvery white appearance. Minute, numerous cleistothecia lie scattered over the white growth. They are dark, spherical, superficially placed measuring 114μ (98–152) in diameter and bear numerous, long, myceloid, delicate, hyaline, aseptate and thin-walled appendages, often unequal in length in the same cleistothecium (Fig. 1, a and b). Appendages are 5μ wide uniformly and slightly uncinuate at the apex. Cleistothecia bear 4–6 ovoid to dacryoid asci which measure 71μ (61–91) \times 45μ (34–68) and

contain 2–6 (commonly 4–6) ascospores (Fig. 1, c and d). Ascospores are oblong, granular and measure 31μ (24–34) \times 17μ (14–21).

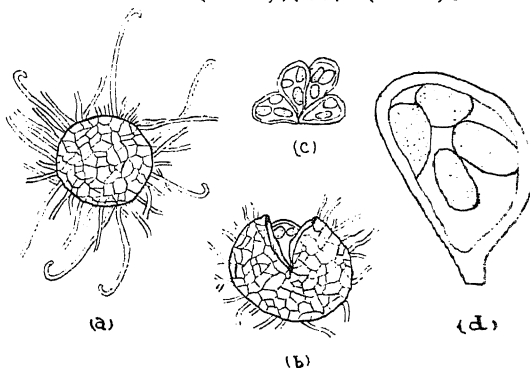


FIG. 1. *Uncinula udaipurensis*, sp. Nov. (a) Cleistothecium with uncinuate appendages. (b) Opening Cleistothecium. (c) Ascus with ascospores. (d) Ascus with ascospores. (a–c, $\times 75$ and d, $\times 300$.)

On the green leaves of *Cordia obligna* Willd. var. *wallichii* (G. Don) Clarke, 17th January 1964, Sajjangarh, Udaipur, M. K. Bhatnagar and K. L. Kothari.

Type specimen deposited at C.M.I., Surrey, England (I.M.I. 108173).

Mycelium septatum, epiphyllum, perstans, effusum, operiens totam paginam superiorem foliorum eamque argenteam aspectu reddens. Cleistothecia minuta plura dispersa per totum mycelium, fusca, sphaerica, superficialiter posita diametentia 114μ (98–152) et supportantia appendices plures longas mycelioides delicatulas hyalinas aseptatas tenuiter parietatos et saepe inaequaliter longas in uno eodemque cleistothecio. Appendices 5μ latae, uniformes et paulisper uncinatae ad apicem. Perithecia supportant ascos 4–6 ovoideos vel dacryioides, qui sunt 71μ (61–91) \times 45μ (34–68) et continent ascosporas 2–6 (vulgo 4–6); ascosporae oblongae, granulares, 31μ (24–34) \times 17μ (14–21).

Typus lectus in foliis viridibus *Cordiae oblignae* Willd. var. *wallichii* (G. Don) Clarke, die 17 Januari 1964, ad Sajjangarh, Udaipur, a M. K. Bhatnagar and K. L. Kothari et positus in C.M.I. in Anglis sub numero I.M.I. 108173.

Authors are grateful to Dr. J. C. F. Hopkins and Dr. K. Pirozynski of C.M.I. England, for confirming the identification of the fungus, to Rev. Fr. H. Santapau, Director, Botanical Survey of India, for the Latin diagnosis, Dr. N. Prasad, Dean, College of Agriculture, Jobner, for guidance and Dr. B. K. Srivastava, Director, Agricultural Experiment Station, for encouragement.

Agric. Experiment Station, M. K. BHATNAGAR.
University of Udaipur, K. L. KOTHARI.
Udaipur (Rajasthan), August 28, 1965.

CHLAMYDOSPORE PRODUCTION BY *TOLYPOSPORIUM CHRISTENSENII* IN ARTIFICIAL CULTURE

Mass cultures of *Tolyposporium christenseii* inciting long smut of *Cymbopogon flexuosus* collected from Kerala (India), turned pale brown in about 6 weeks in P.D.A. which on microscopic examination revealed abundant, thick-walled, yellowish chlamydospores. In view of the absence of any previous reports on this aspect in the genus *Tolyposporium* further observations and studies were undertaken, a brief report of which is given here.

Completion of life-cycle by smut fungi in artificial culture has been so far reported in 17 species belonging to the genera *Entyloma*, *Sphaecelotheca*, *Tilletia*, *Urocystis* and *Ustilago*. The literature on this aspect has been recently reviewed by Fischer and Holton (1957).¹

In the present study, chlamydospores produced in artificial culture in various stages of development were fixed in weak Flemming's solution and stained with Heidenhain's Hematoxylin, differentiated with 2% iron alum, rapidly dehydrated and counterstained with light green.

The chlamydospores were formed from hyphal strands or short segments through fragmentation of the sporogenous mycelium, in a manner characteristic of smut fungi in general. The cells enlarged in size and surrounded themselves with a thick gelatinous membrane. Coiling and intertwining of the sporogenous mycelium gave rise to pockets ultimately resulting in spore-balls typical of the genus. These spore-balls turn black in the course of about four months indicating maturity. Individual chlamydospores in culture were more variable in size (5.5–16.5 μ) than those produced in host (8.3–13.5 μ). Nuclear fusion was found to take place very early in the life-cycle long before the spores were organised, which appears to be a special feature of this smut.

Repeated attempts to obtain germination of these spores were, however, unsuccessful.

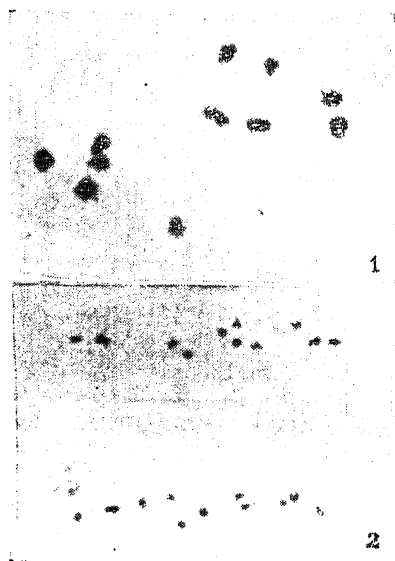
Nuclear status and morphological characters of these chlamydospores obtained in culture are characteristic of true chlamydospores of the genus *Tolyposporium*. This is the first report of the development of true chlamydospores in artificial culture by this genus.

The author wishes to offer his grateful thanks to Prof. M. N. Kamat for his keen interest and guidance.

M.A.C.S. Laboratories, T. RAGHUNATH.
Poona-4, November 20, 1965.

BASIC CHROMOSOME NUMBER IN *CYMOPOGON CAESIUS*

Cymbopogon Spreng. is a genus of aromatic grasses and nearly 16 Indian species are commercially important. Some of these are commonly cultivated for aromatic oil of high economic value. During the course of a survey of the species cultivated in this Garden, I came across one clone, originally collected under the name of *C. martini* (Roxb.) Wats. var. 'Motia' from Bangalore area. This clone possesses $n = 11$ (Figs. 1-2) with perfectly normal



FIGS. 1-2. Metaphase and Anaphase I in *C. caesus*, $\times 4,000$ and $\times 3,000$ respectively.

meiosis. It is distinguishable from *C. martini* proper ($x = 10$) both morphologically and cytologically. The specific diagnosis of the clone reveals that it belongs actually to *C. caesus* (Nees) Stapf, which was very kindly confirmed by Dr. N. L. Bor (Kew). The two species, *C. martini* and *C. caesus*, are closely related not only morphologically but also in chemical characteristics of their oil.¹

A perusal of the cytological literature reveals that *C. caesus* has been worked out earlier by Babu,² who reported it as " $2n = 20?$ and $n = 10 + 1$ ". He did not support this anomalous finding with an illustration. Subsequently, Janaki Ammal³ and Gupta⁴ reported $2n = 20$ in the species. However, the present investigation has not only revealed the unequivocal presence of $n = 11$ (Figs. 1-2) in pollen mother-cells but also $2n = 22$ in root-tips. Evidently, this species perhaps possesses two races with $n = 10$ and 11 .

1. Fischer, G.W. and Holton, C.S., *Biology and Control of Smut Fungi*, Ronald, 1957, p. 622.

Out of about 20 species worked out so far cytologically, 18 are based on $x=10$. The remaining two species have been reported with $2n=24$ in *C. nervatus* (Hochst.) Chiov¹ and $n=10$ and 11 in *C. caesi*us. A thorough survey of *C. caesi*us is needed to isolate the two cytological races, whose cytogenetic study will not only clarify their taxonomic status, but will also throw light on the relationship of $x=10$ and 11. Of the two numbers, 10 is widespread and may have been actually derived from $x=5$. Regarding the origin of $x=11$, two possibilities can be suggested. Firstly it may have arisen from $x=10$ by addition. However, in the present material the additional pair appears to be a normal member of the complement. The other possibility is that $x=11$ may be a secondary basic number, compounded from $x=5+6$. However, I have no clear evidence for the presence of $x=6$ in *Cymbopogon* except perhaps for the presence of $2n=24$ in *C. nervatus* (cf. Bor,¹ p. 130).

I am thankful to the Director and Dr. T. N. Khoshoo for facilities and help during the course of investigation.

National Botanic Gardens, FOJA SINGH.
Lucknow, January 13, 1966.

1. Bor, N. L., *The Grasses of Burma, Ceylon, India and Pakistan*, Pergamon Press, London, 1960.
2. Babu, C. N., *Curr. Sci.*, 1936, 4, 739.
3. Janaki Ammal, E. K., 1945, vide C. D. Darlington and A. P. Wylie, *Chromosome Atlas of Flowering Plants*, George Allen and Unwin Ltd., London, 1955.
4. Gupta, B. K., *Proc. Ind. Acad. Sci.*, 1965, 62 B, 155.

EFFECT OF BOTRYODIPLDIA INFECTION ON THE VITAMIN C CONTENT OF MANGO FRUIT*

STEM-END rot, caused by *Botryodiplodia theobromae* Pat. is one of the important post-harvest diseases of mango (*Mangifera indica* L.). The disease has been reported from India³ and Ceylon.¹ The present investigation was undertaken to study the effect of *Botryodiplodia* infection on the vitamin C content of two important varieties of mango, viz., 'Dashehari' and 'Langra'.

For this purpose both the varieties were inoculated with pure cultures of *B. theobromae* and were incubated at $25 \pm 1^\circ \text{C}$. After the interval of every 48 hours the free ascorbic acid content of the tissue adjacent to the inoculated region was determined. Vitamin C was extracted in 5% metaphosphoric acid and

was titrated against previously standardized 2-6, dichlorophenol-indophenol reagent. The details of the extraction procedures were similar to those followed by Ghosh et al.² The data are presented in Table I.

TABLE I
Showing vitamin C content (in mg. per 100 gm. of fruit pulp) of healthy and infected mangoes and percentage loss in vitamin C†

	Vitamin C content					Percentage loss in vitamin C after 10 days of incubation
	Days of incubation					
	2	4	6	8	10	
<i>Dashehari</i> :						
Healthy ..	20.0	18.7	16.1	13.0	11.7	42.9
Infected ..	16.0	7.4	4.2	3.0	2.1	89.7
<i>Langra</i> :						
Healthy ..	110.0	107.3	99.8	86.5	75.1	32.6
Infected ..	98.2	53.1	26.2	8.5	..	100.0

† The vitamin C content of 'Dashehari' and 'Langra' varieties at the beginning of experiment ('Zero' day of incubation) per 100 gm. of fruit pulp were 20.5 mg. and 110.2 mg. respectively.

From Table I it is obvious that the 'Langra' variety contained more of vitamin C as compared to 'Dashehari'. With the progress of the incubation the vitamin C content of both healthy and infected fruit decreased. In healthy fruits the loss of vitamin C in storage was greater in 'Dashehari' as compared to 'Langra', whereas in the infected fruits the case was just the reverse.

The loss of vitamin C (L-ascorbic acid) may be related to its rapid oxidation (by the enzyme ascorbic acid oxidase or due to the host-parasite interaction) to the diketone lactone form, dehydro-L-ascorbic acid.

The authors are thankful to Drs. S. N. Bhargava and A. K. Ghosh for their help.

Department of Botany, M. P. SRIVASTAVA.
University of Allahabad, R. N. TANDON.
Allahabad (India), February 10, 1966.

* This research has been financed in part by a grant made by the United States Department of Agriculture, Agricultural Research Service.

1. Fernando, M., *Trop. Agriculturist*, 1937, 89, 381.
2. Ghosh, A. K., Bhargava, S. N. and Tandon, R. N., *Indian Phytopath.*, (In press).
3. Srivastava, M. P., Tandon, R. N., Bhargava, S. N. and Ghosh, A. K., *Proc. Nat. Acad. Sci., India*, 1965, 35 B, 69.

EFFICACY OF SEEDLING GRAFTING FOR OVERCOMING INTERSPECIFIC INCOMPATIBILITY IN *LYCOPERSICON*

CROSSES between *L. esculentum* and *L. peruvianum* do not, generally succeed and with a view to overcoming the crossability barrier two methods of grafting were attempted. *L. esculentum* var. *marglobe* and *L. peruvianum* E.C. 2795 were used in the experiment.

In one experiment, reciprocal cleft grafting was done between *L. esculentum* var. *marglobe* and *L. peruvianum* E.C. 2795 prior to hybridization. Mature and healthy plants were selected and thereafter removing the unnecessary leaves and shoots, they were used as root stocks. The scions of about 1" length were cleft-grafted to the stock, using a tight bandage of alkathene tape to secure the union (Figs. 1-3).

rate of growth of the scion was very slow as compared to the cleft graft method. The interspecific crosses were made using the grafted parents. The results obtained in such crosses are given in Table I.

TABLE I

Material	Method	No. of crosses made	No. of plump seeds obtained	No. of hybrids obtained
<i>L. esculentum</i> × <i>L. peruvianum</i>	Control	50	0	0
<i>L. peruvianum</i> + <i>L. esculentum</i> × <i>L. esculentum</i> + <i>L. peruvianum</i>	Cleft grafting	100	0	0
<i>L. peruvianum</i> + <i>L. esculentum</i> × <i>L. esculentum</i> + <i>L. peruvianum</i>	Seedling grafting	100	4	2

Seeds and hybrids could be obtained only from in crosses made in plants raised from seedling grafts. The reasons why the seedling graft method is more effective than the cleft graft technique in overcoming the incompatibility barrier between *L. esculentum* and *L. peruvianum* is not clear. A more extensive study of this problem may yield interesting data.

The author is deeply grateful to Dr. M. S. Swaminathan for suggesting the problem and for his guidance at all stages of this study.

Division of Botany, (MRS.) REHANA MAJID.
Indian Agricultural

Research Institute,
New Delhi, February 14, 1966.

1. Dini, M., *Frutticoltura*, Bologna (Abstracted in *P.B.A.*) 1956, 18, 281.

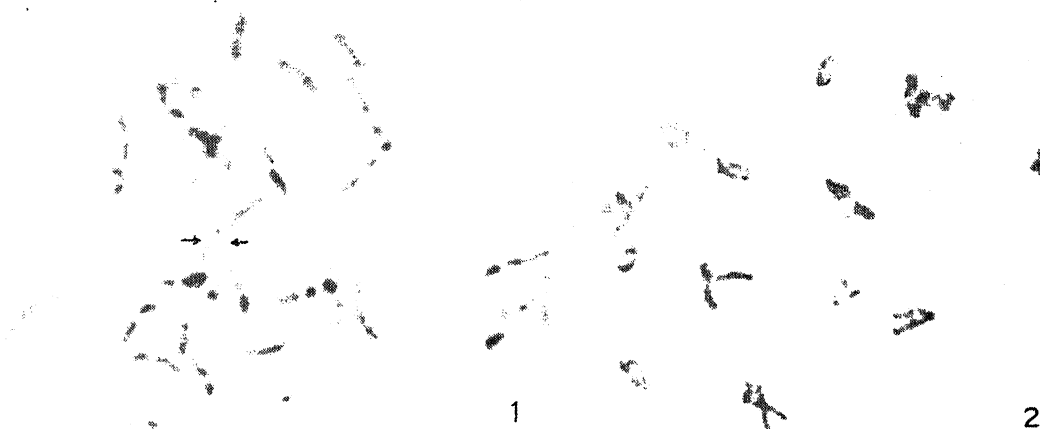
CYTOLOGY OF *GOMPHOGYNE CISSIFORMIS*

Gomphogyne cissiformis Griff. Pl. Cantor., a member of the family Cucurbitaceae, is widely distributed in the Khasia and Jayantia hills of Assam at about 4,000 to 5,000 feet, popularly known as 'Khasia patal' in the locality. The present note deals with the cytology of this species.

Somatic chromosomes have been studied in the root-tip mitosis and the number has been found to be $2n = 32$ (Fig. 1). A pair of satellited chromosomes was invariably present in each cell.

FIGS. 1-3. Fig. 1. Cleft graft between *L. peruvianum* E.C. 2795 and *L. esculentum* var. *marglobe*. Fig. 2. Seedling graft between *L. esculentum* var. *marglobe* and *L. peruvianum* E.C. 2795. Fig. 3. Seedling grafts between *L. peruvianum* E.C. 2795 and *L. esculentum* var. *marglobe*.

In another experiment the seeds of the parents were germinated on moist filter-paper in a petridish. The tiny seedlings at cotyledonary stage were used as scions (Figs. 1-3). The



FIGS. 1-2. Fig. 1. Mitotic metaphase in a root-tip cell showing 32 chromosomes, arrow points satellite chromosomes, $\times 1,875$. Fig. 2. Metaphase I of a pollen mother cell showing different configurations, $\times 1,875$.

The gametic number of $n=16$ has been confirmed in the dividing pollen mother cells. Observations of meiotic metaphase I revealed frequent occurrence of quadrivalents, trivalents and univalents besides normal bivalents (Fig. 2). However, the anaphasic separation is quite normal and 16 chromosomes are distinctly seen to travel to each pole. Anaphase II is also regular and results in the formation of normal tetrads and perfect pollen. The formation of multivalents is an indication that the species is probably a polyploid.

Relatively fewer species in the Cucurbitaceae are known to possess chromosome number of $n=16$, and not a single one has so far been reported to have $n=8$; whereas species with $n=7$ or multiples thereof are far more frequent. This probably led Bhaduri and Bose¹ to believe that 7 was the original base number for the family and the other numbers were derived through either aneuploidy or other means. Whitaker² has already pointed out the improbability of this suggestion and has proposed more than one base number for the family but not including 8. Whitaker's opinion seems to have been influenced by the absence of members with $n=8$. In view of the polyploid nature of the species in question and its somewhat unique chromosome morphology, inclusion of 8 as another possible base number cannot entirely be ruled out.

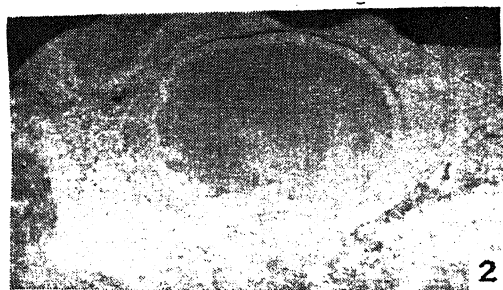
1. Bhaduri, P. N. and Bose, P. C., *Jour. Genet.*, 1947, **48**, 237.
2. Whitaker, T. W. and Davis, G. N., *Cucurbits*, Interscience Publishers, Inc., New York, 1962.

MORE *NYPA* FRUITS FROM THE DECCAN INTERTRAPPEAN BEDS OF MOHGAONKALAN

So far only two specimens of *Nypa* are known from the Deccan Intertrappean beds of India. One was reported by Rode (1933) and described by Sahni (1937). The other specimen was collected and described by Chitale (1960). Two more petrified specimens have been collected by me from the same beds of Mohgaonkalan ($22^{\circ} 10' N$, $79^{\circ} 11' E$) of Chindwara District, Madhya Pradesh.

Specimen No. 1 (Fig. 1) is almost complete and is obovoid in shape. Length of the exposed portion of the fruit, which is almost three-fourth of the original one, is 4.1 cm. The breadth of the specimen is 3.8 cm., at the broadest part. Three facets are seen in the transversely cut portion of the incomplete fruit, and there may be two more to complete the specimen. There is a distinct umbo and an endocarpic ridge. Endocarpic ridge here can be traced from the top of the seed to the middle.

Specimen No. 2 (Fig. 2) is also incomplete in length, but complete in transverse section, showing five facets. Length of the specimen (which is almost half of the original size) is 4.5 cm., and breadth at the broadest part is 4.1 cm. An umbo and a short endocarpic ridge are seen.



FIGS. 1-2. Fig. 1. Specimen No. 1 in l.s., showing umbel, $\times 1.8$. Fig. 2. Specimen No. 2 in t.s., showing facets, $\times 1.4$.

Both these specimens differ from *Nipa hindi* (Rode) Sahni (1937) mainly in the presence of an endocarpic ridge and in size and shape. These specimens differ from the one described by Chitaley (1960), only in the number of facets and in the nature of endocarpic ridge, which is very short in the present specimens.

Both specimens being well preserved, it was possible to study anatomical details, an account of which is being published elsewhere.

I wish to express my sincere thanks to Dr. (Mrs.) S. D. Chitaley for her valuable suggestions and guidance.

Dept. of Botany, E. M. VASUDEVAN NAMBUDIRI.
Institute of Science,
Bombay, February 8, 1966.

A TECHNIQUE FOR MAINTAINING A CONSTANT LEVEL OF SOIL MOISTURE IN POT CULTURE STUDIES

IN field and pot culture studies intended to evaluate the role of differential level of soil moisture on plant growth, surface irrigation has been the most common method of applying water to soil. Although the levels of soil moisture have been fairly accurately maintained at the surface of the soil its uniform distribution throughout the root zone cannot be ensured even though assumed. The results from such experiments have tended to be either inconsistent or inconclusive.

Besides the basic difficulty of unrestricted root zone in field trials the gravity feed system of irrigation both in field and in pots creates a sharp gradient of moisture level down the depth of the soil. This gradient is subject to changes due to tension created by surface evaporation and unaccounted for moisture rise from the soil. The experimental plants are thus exposed to stresses of varying levels of moisture.

These experimental difficulties were desired to be minimised in a pot culture set-up where a given range of moisture level could be maintained constant by allowing the soil within the volume of a pot to reach an equilibrium with the surrounding soil at different moisture tensions.

Four 60 cm. diameter drums, each filled with 8 mesh soil and packed uniformly upto a height of 45 cm., 60 cm. and 90 cm. respectively, were used as capillary towers to conduct water to varying heights from a constant head of 10 cm. water maintained in cisterns below each drum. Flush with the level of the soil, a 25 cm. diameter unglazed earthen pot without hole was buried in each drum. The soil within the volume of the pots alone served as the experimental medium (Fig. 1). For the period of observation the drums were protected against rain.

Under these conditions the moisture from the cistern rose to the top of the soil in the highest drum in four days. But diffusion and equilibrium of moisture from the soil in the drums into the soil of the pots took another 2 days. The equilibrium values of soil moisture at different depths in the pot as compared to the soil moisture levels at corresponding depths in the soil surrounding the pots and another pot which was irrigated on the surface to moisten the soil to the same moisture level as the soil in the pot are presented in Table I.

1. Chitaley, S. D., *Nature*, 1960, **186**, 495.
2. —, *Bull. Bot. Soc., Nagpur*, 1960, **1**, 31.
3. Rode, K. P., *Curr. Sci.*, 1933, **2**, 171.
4. Sahni, B. and Rode, K. P., *Proc. Nat. Acad. Sci., India*, 1937, **7**, 165.

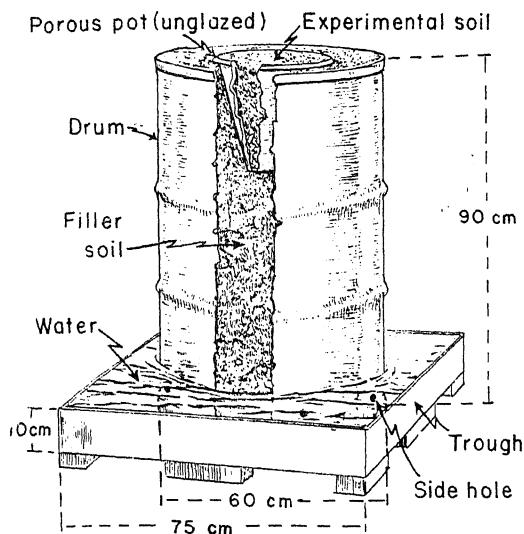


FIG 1. Set-up for maintaining a constant level of moisture in pot.

TABLE I

Effect of different modes of applying water on its distribution within the soil depth

		Moisture per cent. oven-dry soil at		
		0-8 cm.	8-16 cm.	16-24 cm
A	Soil in a porous pot buried in soil column receiving water by capillary rise at constant head from below	26.5	27.2	28.0
B	Soil at corresponding depth in the soil column surrounding the pot	26.5	27.6	28.7
*C	Soil in the pot irrigated from the top to moisten the soil at the same level as in 'A' above	33.2	27.3	20.6

*Values taken soon after all visible moisture had disappeared at the surface. With the lapse of time the moisture gradient gradually flattens and finally reverses.

The moisture gradient set-up in the pots irrigated from the top tends to diminish in the case of soil in the pot where the moisture seeps in through lateral diffusion followed by capillary conductivity. Since the moisture level in the

pot within the drum is primarily controlled by the constant head of water in the cistern the moisture level in the pots remains constant whereas in the pots irrigated from top, the tension set-up due to swelling and evaporation sets up a steep gradient in moisture level down the depth of soil in the pot.

Any desired level of moisture can be maintained in the pot by varying the height of the capillary column. Under the conditions obtaining in this set-up (Table I) the moisture range in the soil of the pots was found to fall between 19.95% and 26.70% moisture fairly uniformly distributed within the depth of the pot (Table II).

TABLE II

Effect of varying height of soil column on capillary rise of moisture

Sampling depth in pot (cm.)	Moisture per cent. oven-dry soil		
	45 cm. column	60 cm. column	90 cm. column
8	25.75	22.69	18.81
16	26.96	24.90	19.96
24	27.38	25.17	21.08
Mean	26.70	24.25	19.95

10 cm. constant head of water maintained below each soil column; soil clay loam; 30% water-holding capacity.

Depending upon the requirement of the crop the size of the pots can be varied to accommodate several replications at one moisture level or as many drums could be set up to accommodate replications separately.

The technique has potential use in several kinds of studies exploring the effect of varying levels of moisture on plant behaviour. However, it should be ascertained in advance whether the rate of capillary conductivity and diffusion of moisture would be fast enough in a particular set-up to meet the requirement of crop growth without disturbing the equilibrium moisture level. This may set a limit to the range of soil moisture within which a crop behaviour can be studied.

Indian Institute of
Sugarcane Research,
Lucknow-2, February 9, 1966.

S. C. SRIVASTAVA.
R. G. MENON.

REVIEWS AND NOTICES OF BOOKS

Quantum Statistics and Co-operative Phenomena. By John G. Kirkwood. Edited by F. H. Stillinger, Jr. (Gordon and Breach, Science Publishers, 150, Fifth Avenue, New York), 1965. Pp. 193. Price: Paper \$4.95; Cloth \$8.00.

The contents of this book are as follows:

I. Quantum Statistics of Almost Classical Assemblies; II. Statistical Theory of Low Frequency Intermolecular Forces; III. The Structure of Liquid Helium with Robert M. Mazo; IV. Atomic Distribution in Liquid Helium-3 with Robert M. Mazo; V. Statistical Thermodynamics of Quantum Fluids with Robert M. Mazo; VI. Quantum Statistical Theory of Plasmas and Liquid Metals with Robert D. Cowan; VII. Quantum Statistical Theory of Electron Correlation with Robert D. Cowan; VIII. Quantum Statistics of Nonideal Systems with Frank H. Stillinger, Jr.; IX. Order and Disorder in Binary Solid Solutions; X. Critical Behavior of Solid Solutions in the Order-Disorder Transformation with H. A. Bethe; XI. Remarks on the Hole Theory of Condensation; XII. On Phase Changes in Crystals Arising from Hindered Molecular Rotation; XIII. Statistical Mechanics of Co-operative Phenomena; XIV. On the Theory of Fusion with Elizabeth Monroe; XV. Statistical Mechanics of Fusion with Elizabeth Monroe; XVI. Note on the Theory of Fusion with Elizabeth M. Boggs; XVII. Phase Transitions in Monolayers due to Hindered Molecular Rotation; XVIII. Crystallization as a Co-operative Phenomenon; XIX. Contribution of Lattice Vibrations to the Order-Disorder Transformation in Alloys, by Peter J. Wojtowicz. C. V. R.

Advances in Hydrosience (Vol. 2). Edited by Ven Te Chow. (Academic Press, New York and London), 1965. Pp. xi + 288. Price \$13.50.

This serial publication is a continuing compilation of the latest available information emerging from the study of water. It covers the physical, chemical, biological, biochemical, radioactive, and hydrodynamical aspects of water; the man-made instruments, machines, and structures employed in connection with water; the use, reuse, and control of water resources; and the many specialized problems occurring within these broader classifications.

The contributions to this volume are: Tsunamis, by W. G. Van Dorn; Chemical Geohydrology, by William Back and Bruce B. Hanshaw; Hydrodynamics of the Dolphin, by Max O. Kramer; Hydromechanics of Inland Navigation, by Shu-Tien Li; Technical Development in Ground Water Recharge, by Paul Baumann. C. V. R.

Thermoanalytical Methods of Investigation. By Paul D. Garn. (Academic Press, New York and London), 1965. Pp. xvi + 606. Price \$19.50.

This volume presents methods of differential thermal and thermogravimetric analysis, including brief descriptions of related techniques. The author discusses the elements of control and recording, comparisons of power supplies, and programming methods. In the section on atmosphere effects, detailed descriptions of static and dynamic atmospheres as well as self-generated atmospheres are included. Techniques for detection, measurement, and identification of effluent gases are described. The methods advanced for quantitative treatment of thermogravimetric and differential thermal analysis curves are reviewed.

The titles of the chapters contained in this volume are listed below: I. Changes in State on Heating; II. Differential Thermal Analysis; III. Operational Parameters; IV. Apparatus for Differential Thermal Analysis; V. Evaluation of Differential Thermal Analysis Curves; VI. Kinetics; VII. Atmosphere Control; VIII. Special Techniques; IX. Thermogravimetric Analysis; X. Thermogravimetric Apparatus; XI. Simultaneous Measurements; XII. Other Techniques; XIII. Miscellaneous Topics; XIV. Analysis of Gaseous Decomposition Products; XV. Recording, Control and Power Equipment; XVI. Miscellaneous Apparatus and Information; XVII. Apparatus Design. C. V. R.

Introduction to Theory of Differential Equations with Deviating Arguments. By L. E. El'sgol'ts. Translated from Russian by Robert J. McLaughlin, Harvard University. (Holden-Day, Inc.), 1966. Pp. 109. Price \$7.65.

This book introduces the basic theory of differential equations with deviating arguments, which has recently found wide application not only in the theory of automatic control but also

in numerous other areas of technology, physics, economics and even in the biological sciences. In order to avoid unwieldy details, only the simplest cases are discussed, supplemented by thorough references. The book is intended for undergraduate and graduate students in university mathematics and physics departments and for engineers concerned with systems with retardation.

The following is the list of chapters contained in this book: I. Basic Concepts and Existence Theorems; II. Linear Equations; III. Stability Theory; IV. Periodic Solutions; and V. Some Generalizations and a Brief Survey of Other Areas of the Theory of Differential Equations with Deviating Arguments. C. V. R.

Probability and Statistics in Psychological Research and Theory. By Donald W. Stilson. (Holden-Day, Inc.), 1966. Pp. xii + 507. Price \$12.65.

This text provides a thorough background in the fundamentals of probability and statistics for advanced undergraduate and graduate students of psychology. Its purpose is to prepare the modern student of psychology for the many advanced topics in statistics he is expected to master in his preparation for advanced degrees—in the belief that a complete training in the basic concepts is simpler and more effective than teaching sophisticated statistical procedures to students inadequately prepared in the fundamentals. No mathematics beyond college algebra is assumed. Numerous non-trivial applications of both probability and statistics to psychological theory are included, with several statistical applications of special interest to clinical psychologists. It provides particularly important training in the use of statistical terms that permits the student to communicate with mathematical statisticians.

The titles of the chapters contained in this book are as follows: I. Introduction; II. Probability, Statistics, and Psychology: Some Common Roots and Converging Interests; III. Fundamental Concepts; IV. Probability: Basic Concepts; V. Probability: Calculations and Special Applications; VI. Random Variables and Measurement; VII. Probability Distributions and Statistical Independence of Random Variables; VIII. Expected Values and Their Estimation; IX. Some Descriptive Characteristics of Populations and Samples; X. Useful Probability Distributions and Density Functions; XI. Sampling Distributions; XII. Introduction to Estimation; and XIII. Introduction to Hypothesis Testing. C. V. R.

Electromagnetic Theory: Static Fields and Their Mapping. By Ernst Weber. (Dover Publications, Inc., 180, Varick Street, New York-14, New York), 1965. Pp. xiv + 590. Price \$2.75.

This Dover edition is an unabridged and corrected republication of the work first published by John Wiley and Sons, Inc., in 1950 under the former title: *Electromagnetic Fields, Theory and Applications, Volume 1—Mapping of Fields*. This edition contains a new Preface by the author.

The titles of the contents of this book are: 1. The Electrostatic Field; 2. The Magnetostatic Field; 3. General Field Analogies; 4. Fields of Simple Geometries; 5. Experimental Mapping Methods; 6. Field Plotting Methods; 7. Two-Dimensional Analytic Solutions; and 8. Three-Dimensional Analytic Solutions.

An excellent text for courses in graduate physics and engineering, the book demonstrates each method from its simplest use to complex examples, and provides problems in every section to be solved by the student. For practising engineers, applied mathematicians and physicists, the book will provide a handy reference and as complete a compendium of theoretical and practical information on field plotting as can be found anywhere. A background knowledge of the electromagnetic field and the principles of vector notation is assumed for the reader. C. V. R.

Advances in Ecological Research (Vol. 3). Edited by J. B. Cragg. (Academic Press, Inc., London and New York), 1966. Pp. xi + 324. Price 80 sh.

The main aim of *Advances in Ecological Research* is to present a comprehensive account of selected topics of ecological research in such a way that biologists with general interest in ecology as well as specialists in ecology, can obtain a balanced picture of what is taking place.

The attention to practical details which is given in all four contributions in the present volume will be of value to advanced students who are faced with the problem of designing certain types of research programmes.

The titles of the contributions in this volume are as follows: The Distribution and Abundance of Lake-Dwelling Triclad—towards a Hypothesis, by T. B. Reynoldson; Energetics, Terrestrial Field Studies, and Animal Productivity, by Manfred D. Engelmann; The Production of Marine Plankton, by J. E. G. Raymont;

The Dynamics of a Field Population of the Pine Looper, *Bupalus piniarius* L. (Lep., Geom.), by H. Klomp. C. V. R.

Essential Chemistry (Vol. 2)—*A Modern Approach for Schools and Technical Colleges*. By K. A. Hassall and C. H. Dobinson. (Iliffe Books Ltd., Dorset House, Stamford Street, London S.E. 1. Pp. 301-502. Price 18 sh. 11 d.)

Volume 1 of this school book of chemistry was reviewed in *Curr. Sci.*

Volume 2 expands the chemistry of metals with the aid of the electrochemical series, and deals with the main nonmetals, elements and gases. The last five chapters are devoted to an introduction to simple organic chemistry and covers hydro-carbons, alcohols, organic acids, food, plastics, and explosives. A. S. G.

Relativity and the New Energy Mechanics. By Jakob Mandelker. (Philosophical Library, Inc., 15, East 40th Street, New York), 1966. Pp. 84. Price \$ 4.00.

According to the author relativity mechanics, as it exists in the present form, has been found incomplete in its basic formulation. Only by retracing our steps to the origins of the theory and by re-evaluating the basic concepts with regard to their physical meaning, can we hope to obtain an orderly picture of the essential physical content of relativity theory especially of its basic mechanics. This the author attempts to do in this monograph published by the Philosophical Library, New York. A. S. G.

Weather Studies. By L. P. Smith. (Pergamon Press, Headington Hill Hall, Oxford), 1966. Pp. 131. Price 15 sh.

This publication comes under the Rural and Environmental Studies Division of the Commonwealth and International Library. It is an elementary book on meteorology treated as a branch of physics to be taught in schools. Emphasis is on the experimental aspects of measuring the weather elements and their interrelationships which are shown by graphs, diagrams and maps. The treatment is in the form of a series of assignments to pupils. A. S. G.

Books Received

Hermann Von Helmholtz. By L. Koenigsberger. (Dover Publications, New York), 1965. Pp. xvii + 440. Price \$ 2.25.

The Foundations of Genetics. By F. A. E. Crew. (Pergamon Press, Headington Hill Hall, Oxford), 1966. Pp. xiii + 202. Price 21 sh.

Sand and Water Culture Methods Used in the Study of Plant Nutrition (Second Edition). By E. J. Hewitt. (Commonwealth Agricultural Bureaux, Farnham Royal, Bucks, England), 1966. Pp. xiii + 547. Price \$ 15.

Energetics in Metallurgical Phenomena (Vol. II). Edited by W. M. Mueller. (Gordon and Breach, Science Publishers, Inc., New York), 1965. Pp. ix + 203. Price: Paper \$ 5.50; Cloth \$ 5.50.

Visual Illusions—Their Causes, Characteristics and Applications. By M. Luckiesh. (Dover Publications, New York), 1965. Pp. xxi + 252. Price \$ 1.50.

Probability and Statistics in Psychological Research and Theory. By D. W. Stilson. (Holden-Day, Inc., 728, Montgomery Street, San Francisco), 1966. Pp. xii + 507. Price \$ 12.65.

Control of Energy Metabolism. Edited by B. Chance, R. W. Estbrook and J. R. Williamson. (Academic Press, New York), 1965. Pp. xii + 441. Price \$ 10.50.

World List of Abbreviations. By F. A. Buttress. Leonard Hill Books, Grampian Press, Ltd., 8-10, King Street, Hammersmith, London W. 6), 1966. Pp. vi + 186. Price 35 sh.

Advances in Insect Physiology (Vol. 3). By J. W. L. Beament, J. E. Treherne and V. B. Wigglesworth. (Academic Press, New York), 1966. Pp. x + 382. Price 80 sh.

British Initials and Abbreviations. Compiled by Ian H. Wilkes. (Leonard Hill Books, Grampian Press, Ltd., 8-10, King Street, Hammersmith, London W. 6), 1966. Pp. 125. Price 45 sh.

Problems in Particle Physics. By A. N. Kamal. (McGraw-Hill Publishing Co., Ltd., Maidenhead, Berkshire, England), 1966. Pp. vii + 126. Price 38 sh.

Advances in Chromatography (Vol. I). Edited by J. Calvin Giddings and R. A. Keller. (Marcel Dekker, Inc., New York), 1965. Pp. xv + 392. Price \$ 14.50.

Weather Prediction by Numerical Process. By L. F. Richardson. (Dover Publications, Inc., New York), 1965. Pp. xvi + 236. Price \$ 2.00.

MORPHOLOGY OF THE ANTHER TAPETUM OF ANGIOSPERMS

K. PERIASAMY AND B. G. L. SWAMY

Department of Botany, Presidency College, Madras

THE anther tapetum of angiosperms is presumed to be the tissue that serves for the nutrition of the microsporogenous cells during the development of the latter into the microspores. Although it is not yet known how exactly this function is discharged, the functional aspect of tapetum is evident from the following facts: (1) The tapetum invariably exhibits characteristic and profound morphological changes, and gradually undergoes degeneration during the time of sporogenesis. (2) As a rule, the tapetum completely surrounds the mass of sporogenous tissue and hence any nutritive substance needed for the latter must necessarily pass through the tapetum.

Since the basic phenomenon that underlies the concept of tapetum as a separate morphological entity, is its functional role, this aspect of the tapetum has received much of the attention of investigators. On the other hand, the morphological aspect of the tapetum has not been looked into with critical enquiry, and whatever information that is available is most often physiologically oriented. Thus we see that the nuclear behaviour, the cytoplasmic configuration, the time of degeneration, its role in the nutrition of the sporogenous tissue, etc., are features that are usually described not only in ontogenetic accounts of tapetum of individual species but also in reviews and books (Maheshwari, 1950; Wunderlich, 1954). However, the one important aspect of tapetum that perhaps has, more than anything else, influenced its morphological aspect, is the remarkably uniform physiological behaviour of its constituent cells. The tapetum, therefore, appears to constitute a single, indivisible unit. This physiological homogeneity has obviously led to the assumption also of a morphological homogeneity. Since in most of the angiosperms the cells of the innermost of the wall layers derived from the primary parietal tissue function as tapetal cells, the 'normal' type of tapetum of angiosperms is invariably considered to be the product of only the innermost wall layer.

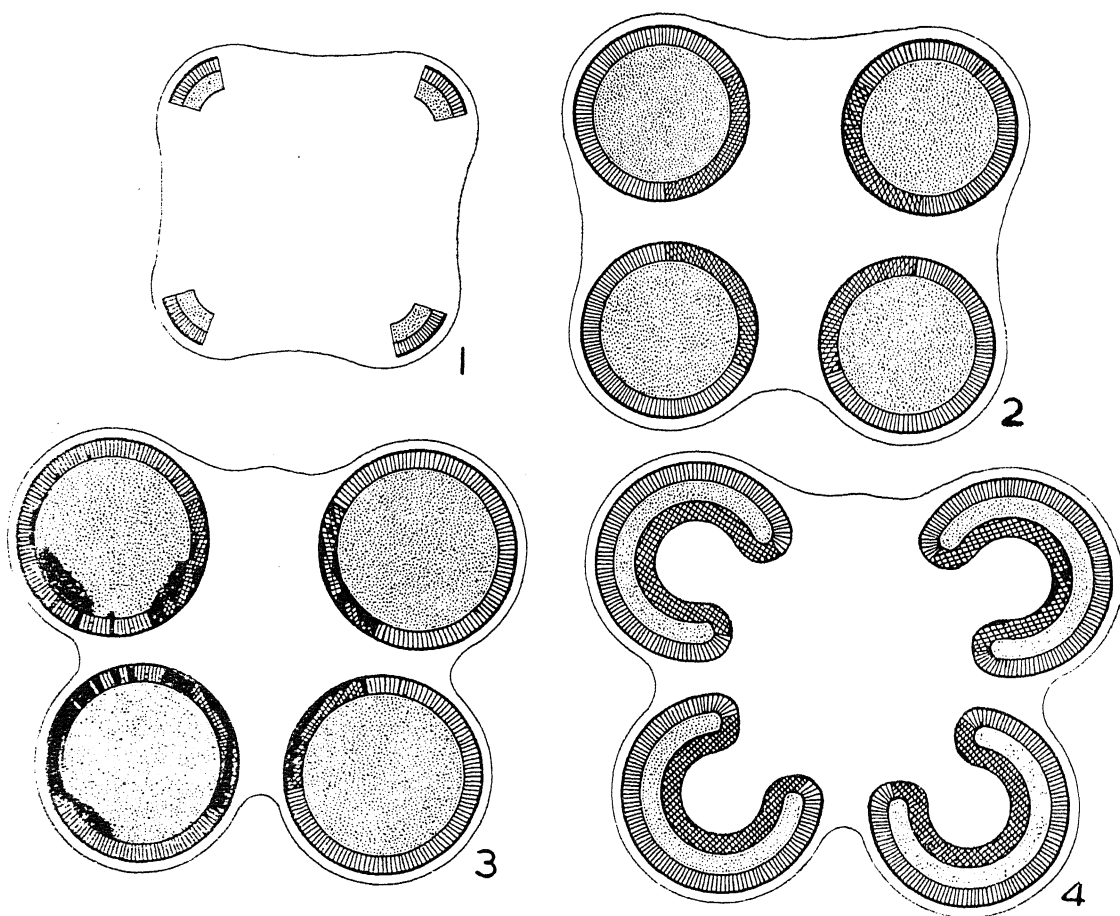
Although a concept of morphological homogeneity has by and large pervaded and influenced most of the investigations on ontogeny of the anther, instances are not lacking where the supposed homogeneity is said to be absent, and a morphological duality reported to be

present (Boke, 1949; Maheshwari, 1950; Periasamy, 1955; Periasamy and Swamy, 1959, 1964; Budell, 1963; Periasamy and Parameswaran, 1965). The few instances of such reports, however, have failed to influence and modify the older and widespread morphological concept. Thus, Steffen and Landmann (1958), who have discussed the morphology and variations of the anther tapetum of angiosperms, state that the 'normal' type of tapetum, that obtains in a majority of angiosperms and forms their type I, develops from the derivatives of the parietal cell. Similarly, their types II and III are also assumed to be morphologically homogeneous, the former being a sterilization product that arises by a periclinal division of the secondary archesporium, and the latter by a peripheral or a random sterilization of the archesporial cells.

First, let us consider the sequence of ontogeny of the 'normal' tapetum of angiosperms. As stated by Periasamy and Swamy (1964), the archesporium, which must be looked upon as the initials of the microsporangium, divides periclinally to give rise to the outer, primary parietal tissue, and the inner, primary sporogenous tissue. Although in some species the archesporium differentiates as a single longitudinal row of cells in each of the four corners of the anther primordium, in most species it appears to differentiate as a plate of more than two or three cells in width. In either case, the primary parietal tissue abuts on the external face alone of the primary sporogenous tissue and does not extend to the lateral and inner faces (Fig. 1). During subsequent ontogeny both the primary parietal tissue, and the primary sporogenous tissue, undergo developmental changes with accompanying multiplication of cells. These changes bring about marked modifications in the initial configuration of the two tissues, not only in relation to one another but also with respect to the anther as a whole. Anticlinal and periclinal divisions in both the tissues result in the development of a variable number of wall layers and the formation of a massive sporogenous tissue (except where it is uniseriate). The sporangium as a whole bulges out to varying extent depending upon the massiveness of the sporogenous tissue and the degree of development of the extrasporangial tissues of the connective region. During the process of bulg-

ing out, the wall layers derived from the parietal tissue extend as an arc along the outer face of the sporangium (Figs. 2-4), the greater

not been reported, nor is there any possibility of such an occurrence. Even in *Cananga odorata* (Periasamy, 1955) in which the sporo-



FIGS. 1-4. Figs. 1-3. Successive stages in the development of the 4 microsporangia in the anther. Fig. 4. Mature anther showing intrusion of connective tissue into the microsporangia. All figures diagrammatic. Parietal tissue and tapetum derived from it single-hatched; tapetum derived from connective cross-hatched; sporogenous tissue stippled.

the bulging the wider being the arc (see also Periasamy and Swamy, 1964). Nevertheless, even a superficial examination of the cellular readjustments involved in the growth pattern of the sporangium would show that whatever be the extent of the wall tissue complex, it does not extend to the inner face of the sporangium towards the connective, a feat which requires the girdling of the wall layers around the sporogenous tissue by 180° on its either arm. Such a feat can be accomplished only by extensive sliding or intrusive growth of the cells or cell layers of the wall tissue; so far such a growth pattern of ontogeny has

genous tissue forms a uniseriate row, and hence requires a minimum extension of the wall layers to engirdle the sporogenous tissue, a careful study of the ontogeny reveals that none of the wall layers does so extend to the side towards the connective. Such being the case even in the instance of a uniseriate sporogenous tissue, in plants which have a plate of archesporium and a massive sporogenous tissue it would be an ontogenetic improbability for any of the wall layers to extend to the inner face of the sporangium, diametrically opposite to the position of origin of the primary parietal tissue.

From the foregoing considerations it may safely be concluded that in the angiosperms, the wall layers derived from the primary parietal tissue do not extend fully around the sporogenous tissue and especially fail to cover its inner face towards the connective. The tapetum as a rule arises from the innermost of the wall layers although in certain instances more than one layer may be regularly or irregularly involved (Wunderlich, 1954). In any case, the tapetum that results from the wall layers would represent only that particular portion which abuts on the outer face of the sporogenous tissue and does not account for the whole of the tapetum that covers the sporogenous tissue all around. Therefore a certain part of the tapetum situated towards the inner face of the sporogenous cell mass must necessarily arise from a tissue that does not morphologically belong to the wall layers, and consequently is *not* a derivative of the primary parietal tissue. Indeed, the tapetum towards the inner face arises from the derivative cells of the connective that initially abutted on the archesporium. Thus, morphologically, the tapetum has a *dual* origin, partly from the wall layer or layers and partly from the cells of the connective, the relative proportion of the two depending upon the configuration of the sporangium in relation to the connective (Figs. 3, 4).

In spite of the morphological duality, it is true, as stated already, that the entire tapetum becomes in most plants remarkably homogeneous in regard to its cellular alignment as a single layer, the size and structure of its individual cells, and their cytological and physiological behaviour. However, instances are not altogether lacking in which the morphological duality is indicated also by differences in arrangement, size and behaviour of the different parts of the tapetum. In a majority of plants belonging to the Acantheaceae and other Bicarpellatae (Maheshwari, 1950), the tapetal cells on the inner face elongate radially to a marked extent in comparison to those on the outer face. In *Taremma asiatica* (Periasamy and Parameswaran, 1965), the tapetum on the outer face consists of a single layer of regularly aligned cells, but on the inner face it comprises more than one layer of irregularly arranged cells, and a careful study of the ontogeny reveals that the differences in configuration correspond to differences in morphology. Such structural and physiological differences within the tapetum, either in its fully formed state or during ontogeny, may be more widespread than what is

reported at present, if only critical studies, that are lacking, are made on the ontogeny of the anther and the tapetum.

Apart from the relatively lesser number of instances of the visible expression of the morphological duality, of the tapetum, the homogeneity that bears no indication of such duality, attained in most angiosperms, must be looked upon as an instance of analogy and an example of how plants can fulfil their functional needs through diverse morphological and morphogenetic pathways. This would naturally be disconcerting to morphologists who may like to have such a homogeneous and compact tissue as the tapetum to be also morphologically homogeneous, in order that the importance of morphology be all-pervading without being minimised when it comes in face with the functional aspects. In fact it is this deeply rooted sense of the importance of morphology that may have been responsible for perpetuating the idea that the tapetum is a morphologically homogeneous tissue, but facts speak otherwise in this regard.

Within the major plant groups the sporangium exists in several levels of specialization (see also Periasamy and Swamy, 1964), from a condition in which it consists of nothing more than a spore mass, to a complex one, in which the spore mass is associated with structures that serve for the nutrition, protection and controlled distribution of the spore mass. It is generally believed that these structural associates have resulted from the setting apart, or what is called sterilization, of a part of the spore mass for other functions. In other words, a division of labour sets in the morphologically homogeneous sporogenous mass. The exact stage in ontogeny at which the division of labour commences, however, varies widely. It may start after the sporogenous mass has attained its final number of cells, when some of them instead of developing the morphological characteristics of spores, develop into other structures such as tapetum and wall, or degenerate to contribute to the nutrition of those destined to mature as spores. The division of labour may also commence at earlier stages when cell multiplication in the sporangium has not yet ceased, so that either one or both the functionally-divided parts continue to divide further and multiply in cell number, during which process further division of labour may occur in one or both. In this trend of specialization, if we may consider that the earlier the division of labour sets in the more specialized the sporangium is, the extreme expression of specialization would be the begin-

ning of division of labour at the very first division of the sporangial initial or initials. Indeed, this is the case in the microsporangium of angiosperms, because the very first division of the archesporium, which must be viewed as the initial of the microsporangium, sets apart a parietal tissue that does not contribute anything to the sporogenous mass, and a sporogenous tissue which gives rise to the spores proper.

During the multiplication of cells of the parietal tissue, further division of labour takes place into tapetum and wall layers, the latter then segregating into the middle layer or layers and the endothecium. Although there may be some ontogenetic variation in the sequence of division of labour, in general it suggests that the tapetum is an earlier specialization than the endothecium. In fact, the tapetum is first seen at the pteridophytic level, whereas the endothecium emerges only in the angiosperms. As surmised by Periasamy and Swamy (1964), the emergence of endothecium, as the counterpart of the exothecium in gymnosperms, appears to be related to the isolation of the outermost layer as a mere 'skin' with very limited morphogenetic potentialities, in the fundamental organization of the plant body of the angiosperms as a whole.

In contrast to the parietal tissue, no subsequent division of labour takes place in the sporogenous tissue in the majority of angiosperms. However, there are instances where some of the sporogenous cells may, instead of functioning as spore mother cells, serve as sterile partitions or tapetal cells as in *Cananga odorata* (Periasamy and Swamy, 1959), and in the Gentianaceae and the Geraniaceae tapetum (type III of Steffen and Landmann, 1958). The unique case of the Cyperaceae in which even after meiosis, three spore nuclei of each tetrad degenerate and only one develops, may also be mentioned as a very late division of labour in the spore mass.

Hand in hand with the above-stated trends of specialization, the microsporangium of angiosperms has also become a sunken structure due to the loss of an individual stalk. This has done away with the necessity of production of a

complete and morphologically homogeneous wall all around the spore mass, because the tissue of the connective itself adequately serves this function toward the inner, sunken face (Periasamy and Swamy, 1964). With the loss of the wall toward the inner face, the production of the tapetum, which is a function of the wall layers, becomes also ceased, and the connective tissue, that replaces the wall here, naturally takes up also the function of giving rise to the tapetum in the concerned region. Thus, from a consideration of the phylogenetic modification of the microsporangium as well, it seems but natural that the tapetum toward the inner face of the sporangium of angiosperms should arise from cells of the connective and not from the wall layers.

It may therefore be concluded that the anther tapetum of angiosperms, although physiologically homogeneous in most instances, is morphologically heterogeneous, being derived in part from the parietal tissue toward the bulging, outer face of the sporangium, and in part from the cells of the connective toward the sunken, inner face.

1. Boke, N. H., "Development of the stamens and carpels in *Vinca rosea* L.," *Amer. J. Bot.*, 1949, **36**, 535.
2. Budell, B., "Untersuchungen der Antherentwicklung einiger Blütenpflanzen," *Z. Bot.*, 1963, **52**, 1.
3. Maheshwari, P., *An Introduction to the Embryology of Angiosperms*, McGraw-Hill Book Co., New York, 1950.
4. Periasamy, K., *Studies in the Annonaceae Embryology of Cananga odorata and Millettia wightiana*, Thesis, University of Madras, 1955.
5. — and Parameswaran, N., "A contribution to the floral morphology and embryology of *Tarenna asiatica*," *Beitr. Biol. Pflanzen*, 1965, **41**, 123.
6. — and Swamy, B. G. I., "Studies in the Annonaceae. 1. Microsporogenesis in *Cananga odorata* and *Millettia wightiana*," *Phytomorphology*, 1959, **9**, 251.
7. — and —, "Is the microsporangium of angiosperms wall-less?" *Curr. Sci.*, 1964, **33**, 735.
8. Steffen, K. and Landmann, W., "Entwicklungsgeschichtliche und cytologische Untersuchungen am Balkentapetum von *Gentiana cruciata* L. und *Impatiens glandulifera* Royle.," *Planta*, 1958, **50**, 423.
9. Wunderlich, R., "Über das Antherentapetum mit besonderer Berücksichtigung seiner Kernzahl," *Österr. bot. Z.*, 1954, **101**, 1.

CHEMICAL INVESTIGATION OF WAX FROM LARVAE OF *LACCIFER LACCA*

HARBHAJAN SINGH, T. R. SESHADRI AND G. B. V. SUBRAMANIAN

Department of Chemistry, University of Delhi, Delhi-7, India

THE results of a preliminary investigation on the components of the larvæ were reported earlier.¹ It was found that the larvæ contain primarily wax, ether-insoluble hard resin and water-soluble colouring matters. The nature of the colouring matters has been elucidated recently.² The present communication describes the chemical composition of the wax.

The wax from the *Kusmi* strain of larvæ was extracted by the procedure described earlier.^{1,2} It was obtained as a pale yellow powder. It did not give a characteristic Liebermann-Burchard test indicating the absence of a sterol wax. The infrared absorption spectrum gave an intense band for ester carbonyl at 1724 cm.⁻¹ and was free from any absorption due to carboxylic carbonyl. Further, it did not show the presence of any alkali-soluble fraction indicating the absence of any free acids.

The wax has been separated by boiling with hot ethanol into an ethanol-soluble (fraction I) and an ethanol-insoluble (fraction II) parts, each studied independently. Fraction I was obtained as a pale yellow waxy mass while fraction II was a colourless powder, m.p. 89-90°. Both the fractions were then saponified and separated into acidic and neutral fractions. The completeness of the saponification was checked by thin layer chromatography. From ethanol-soluble wax a mixture of acids (IA) was obtained as a pale yellow soft mass. The non-saponifiable fraction (IB), m.p. 84-86°, was free from any carbonyl absorptions in the infra-red spectrum. The acids (IIA) from ethanol-insoluble portion had a melting point 89-90° while the non-saponifiable (IIB) had m.p. 91-92°. These fractions were then studied by chromatographic methods.

A paper chromatographic study of the wax (I) on paraffin oil impregnated paper showed the absence of free fatty acids. The acid fraction (IA) obtained by saponification was found to contain C₁₄, C₁₆ and C₁₈ chain lengths by parallel run of authentic samples. A considerable amount of it was slow moving as compared to C₁₈ acid and thus had higher chain length. Ethanol-insoluble wax was also free of any fatty acids. The fatty acids obtained by saponification were found to be all of high

chain length as compared to C₁₈ and were completely free of lower chain lengths.

In order to detect the presence of hydrocarbons column chromatography was used. The behaviour of the total larval wax on neutral alumina indicated the absence of hydrocarbons and free acids. As a check that no hydrocarbon had passed on along with the ester fraction, the non-saponifiable fractions IB and IIB were also chromatographed on neutral alumina and were found to be devoid of hydrocarbons.

Thin layer chromatography on silica gel was next used in order to get information about the alcohols present and further details about the components of the wax. However, it does not show difference between neighbouring homologues; only large differences in chain lengths are shown: (a) Ethanol-soluble wax indicated the presence of wax esters moving as a group without resolution and considerable amount of free fatty alcohols which were resolved. One group of free alcohols was in high proportion as shown by its intensity. The non-saponifiable fraction IB indicated the presence of the same alcohols. (b) Ethanol-insoluble wax showed the presence of only esters. The non-saponifiable fraction IIB gave a single spot representing alcohols of high chain length. The acids IIA were converted into the corresponding alcohols and a thin layer chromatography of this showed two spots, of which the less intense corresponded with IIB, while the more intense spot had a slightly lower R_f. This showed that ethanol-insoluble wax is made up of alcohol of one chain length group whereas the acids are made up of two such groups, major one having higher chain length. A thin layer chromatographic comparison of fractions I, IB and IIB showed that the major free fatty alcohols in these belong to the same average chain length group.

GAS-LIQUID CHROMATOGRAPHY

In recent years gas-liquid chromatography has been found to be a versatile tool for detailed study of the composition of oils, fats and waxes. In the present work it has been found to be very useful for understanding the composition of the acids, alcohols and hydrocarbons.

(a) *Ethanol-Soluble Wax*.—The fatty acids (IA) were converted into their methyl esters by methanol-benzene in presence of sulphuric acid. A preliminary purification of the methyl esters was done by passing through a short column of neutral alumina and eluting with light petroleum and benzene. The former eluted mostly a colourless liquid, while the benzene fraction gave a small amount of a pale yellow waxy mass. A gas liquid chromatography of the petroleum ether fraction on polyethylene glycol adipate as stationary phase indicated the presence of methyl esters of acids of chain length C_{12} , C_{14} , C_{16} and C_{18} (saturated), C_{14} , C_{16} and C_{18} (monounsaturated) and C_{18} (triunsaturated). The main fatty acids were C_{14} , C_{16} (saturated) and C_{18} (unsaturated). The benzene fraction did not show any peak upto C_{18} ester, and thus had higher chain length.

A further confirmation of above chain lengths was obtained when esters were converted into the corresponding hydrocarbons. A gas-liquid chromatography of these showed the presence of C_{12} , C_{14} , C_{16} , C_{18} (monounsaturated), C_{20} and C_{22} chain length.

In order to determine the chain lengths of the alcohols of IB, they were converted into corresponding hydrocarbons. A gas-liquid chromatography analysis indicated minor amounts of C_{14} , C_{16} and C_{18} hydrocarbons while the main fraction was not eluted from the column under the conditions in which C_{26} hydrocarbon could be eluted. This showed that non-saponifiable fraction IB has minor amounts of alcohols of C_{14} , C_{16} and C_{18} chain length while the main fraction has a chain length of above 26 carbon atoms.

(b) *Ethanol-Insoluble Wax*.—The fatty acids (IIA) were converted into corresponding hydrocarbons, because the paper chromatographic analysis showed absence of lower chain lengths and therefore the methyl esters would be unsuitable for gas-liquid chromatography. But the resulting hydrocarbons were found to contain minor amounts of C_{12} , C_{14} , C_{16} and C_{18} chain lengths indicating the presence of these fatty acids, not detected by paper chromatography. There was a minor amount of an unidentified peak around C_{20} region while the main hydrocarbons were not eluted from the column

in a time in which authentic samples of hydrocarbons upto C_{26} chain length could be eluted. Thus fraction IIA constitutes minor amounts of C_{12} , C_{14} , C_{16} and C_{18} chain length while the major fractions of fatty acids has a chain length above C_{26} carbon atoms.

In a similar way, the non-saponifiable fraction IIB was converted into the corresponding hydrocarbons and the gas-liquid chromatographic analysis carried out. It did not show any chain length upto C_{26} . The melting point of hydrocarbon was $67-69^\circ$ and indicated that the chain length was above C_{30} carbon atoms and was free from any lower hydrocarbons.

Summarising the results the larval wax has been examined using the different methods of chromatographic analysis. The main differences between ethanol-soluble and insoluble wax is that the former is made up of wax esters and free fatty alcohols while the latter contains only wax esters. The combined fatty acids present in ethanol-soluble wax have lower chain lengths as compared to those obtained from ethanol-insoluble wax and this may be responsible for differences in solubility properties. Further, the wax esters of larvae are made up of alcohols belonging mainly to one chain length group whereas the acids are more complex and larger in number.

It may be useful to compare the composition of the wax from the lac larvae with that of stick lac. The stick lac wax has been previously studied by a large number of workers³ and their results are contradictory. Recently Michel and co-workers⁴ have studied this more extensively using modern methods of chromatography and their results differ from those of larval wax, obtained now.

ACKNOWLEDGEMENT

Our thanks are due to the Director, Lac Research Institute, for the supply of fresh larvae.

1. Madhav, R., Seshadri, T. R. and Subramanian, G. B. V., *Curr. Sci.*, 1962, **31**, 137.
2. Harbhajan Singh, Seshadri, T. R. and Subramanian, G. B. V., *Tetrahedron Letters*, 1965, p. 1101.
3. Bose, P. K., Sankaranarayanan, Y. and Sen Gupta, S. C., In *Chemistry of Lac*, Indian Lac Research Institute, Ranchi, Bihar, India, 1963.
4. Michel P. and Fanrot-Bouchet, *J. Am. Oil Chemists Soc.*, 1964, **41 B**, 418.

INDUCTION OF GASTRIC ULCERS BY ACID FEEDING IN THE TOAD,
BUFO MELANOSTICTUS SCHN.

E. M. SHERIFF AND M. APPASWAMY RAO

Department of Post-Graduate Studies and Research in Zoology, Manasa Gangotri,
Mysore-6, India

THE ætiology and pathogenesis of gastric ulcer is not clearly established. The most favoured hypotheses are gastric hypersecretion, decreased tissue resistance and vascular occlusion.¹ Ulcers induced by polymyxin-B,² histamine³ or 'Shay' operation⁴ may be due to hyperacidity. However, in steroid-induced ulcers there is decreased acid and mucous secretions in the stomach.⁵ As there is no direct evidence to show that hyperacidity causes ulcers, this problem is investigated.

The toad, *Bufo melanostictus* Schn., is chosen for experimentation, because of its slow response, increased resistance to stress and easy availability. Animals weighing 30 to 50 gm. were

and muscularis externa (Fig. 1). Administration of 0.25 N HCl causes inflammation of the stomach and interstitial hæmorrhages in the superficial gastric mucosa. With 0.5 N HCl there is erosion of superficial gastric epithelium exposing gastric glands (Fig. 2). Definitive ulcers, with the erosion of entire gastric mucosa, are seen with 0.75 N HCl treatment (Fig. 3). Acute and deep ulceration results with 1 N HCl wherein there is complete erosion of gastric mucosa and muscularis mucosa with perforations in the submucosa and muscularis externa (Fig. 4). The severity of ulceration increases to a maximum with 1.25 N HCl treatment (Table I).

TABLE I

Effect of graded doses of hydrochloric acid on the induction of gastric ulcers in the toad

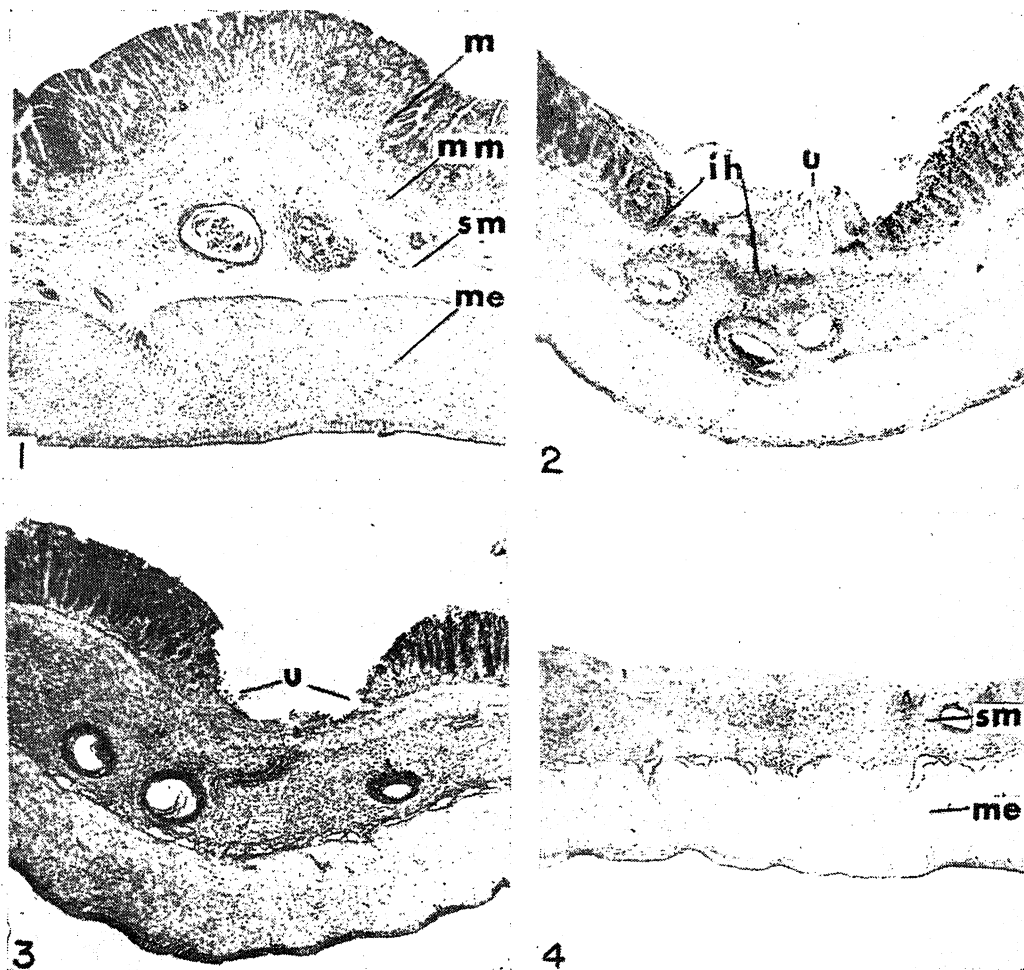
Treatment	Per cent. difference in Body weight	Per cent. Mortality	Ulcers			
			Number per toad (M \pm S.E.)	Severity (M \pm S.E.)	Per cent. incidence	Index *
Control (14)	+6.46	—	—	—	—	—
Hydrochloric Acid:						
0.25 N (9)	+5.24	—	1.0 \pm 0.19	0.38 \pm 0.01	75	8.88
0.5 N (16)	+9.35	—	2.6 \pm 0.34	1.28 \pm 0.27	93	13.13
0.75 N (10)	+9.52	10	5.8 \pm 0.81	2.80 \pm 0.40	100	18.60
1.0 N (13)	-4.25	23	6.7 \pm 0.38	3.50 \pm 0.07	100	20.20
1.25 N (8)	-8.43	50	9.0 \pm 1.87	4.00 \pm 0.00	100	23.00

Number in parenthesis denotes number of toads. M \pm S.E. = Arithmetic Mean \pm Standard Error.* Ulcer Index⁶ = Number of ulcers per toad + Severity (graded from 0 to 4+ based on the depth of ulcer) + Per cent. Incidence $\times 10^{-1}$.

starved for two days, later 0.5 ml. of 0.25 N to 1.25 N hydrochloric acid (HCl) (BDH) was administered per os, per toad twice a day for five days. The controls received equal amount of distilled water for the same period. All toads were autopsied 12 hours after the last feed, the stomach was dissected out, the number and severity of the ulcers were noted.⁶ The ulcerated portion was fixed in Bouin's fluid, sectioned and stained in Harris' hæmatoxylin-eosin and Mallory's triple stains. A total of 70 female toads were used.

The stomach of the control toad shows normal gastric mucosa, muscularis mucosa, submucosa

Administration of adrenocortical steroids causes acute ulcers in rats without influencing the rate of gastric secretion.⁶ The causative factors for ulceration appear to be decreased mucous secretion and tissue resistance.⁵ Polymyxin-B² or histamine³ treatment induces ulcers due to increased acidity in gastric secretion. The present experiment supports the view that hyperacidity causes ulcers, but whether it is due to hypersecretion of adrenals caused by the acid or by the release of histamine or serotonin by the connective tissue of the submucosa is not clear. This experiment offers an excellent method of inducing graded degrees



FIGS. 1-4. Transverse section of the stomach of the toad, $\times 45$ (Harris' hæmatoxylin-eosin). Fig. 1. Control—showing normal mucosa and musculature of the stomach. Fig. 2. 0.5 N HCl treated—gastric epithelium is eroded exposing the gastric glands. Fig. 3. 0.75 N HCl treated—showing a definitive ulcer. Fig. 4. 1.0 N HCl treated—Acute ulcer showing loss of mucosa and muscularis mucosa with perforations in submucosa and musculature. (ih= interstitial hæmorrhage; m=gastric mucosa; me=muscularis externa; mm=muscularis mucosa; sm=submucosa; u=ulcer.)

of ulceration for testing anti-ulcerogenic drugs.

The award of a Research Fellowship to E.M.S. by the Loganathan-Tarapore Trust, Madras, is gratefully acknowledged. Our thanks are due to the University of Mysore for research facilities and to Sri Ramakrishna Raju for the photomicrographs.

LETTERS TO THE EDITOR

MEASUREMENT OF THE INTERNAL CONVERSION COEFFICIENT OF THE 800 keV TRANSITION OF Ba-134

THE mode of disintegration of Cs-134 isotope and the subsequent transitions in Ba-134 nuclei have been studied recently^{1,2} in view of the lack of agreement in the earlier proposed level schemes. Employing high resolution Ge(Li) gamma-ray spectrometer and a precision $\pi\sqrt{2}$ beta-ray spectrometer Brown and Ewan² have proposed a consistent decay scheme for Cs-134. Although the gamma-ray spectrum is complex, most of the gamma lines are quite weak in intensity compared to the 605 and 796 keV lines. Closely lying beside the 796 keV line, another line at 802 keV is present. These two cannot be resolved by a beta-scintillation spectrometer owing to its poor resolution, and so the combination is designated in the present work as 800 keV transition in accordance with an earlier proposed decay scheme.¹ This 800 keV transition stands well separated from the other gamma lines by about 200 keV on either side. Hence this transition is chosen to investigate the applicability of the internal-external-conversion technique employing a beta scintillation spectrometer³ for the measurement of the internal conversion coefficient (ICC). The technique being simple and inexpensive and since it is capable of yielding results of useful accuracy, its applicability is ascertained by comparing the measured value of the ICC for the 800 keV transition with the earlier experimental as well as theoretical values.

The Cs-134 isotope of 2.1 yr. half-life is obtained as caesium chloride in dilute HCl, having a specific activity of 100 mC./gm. from the AEET, Bombay.

The experimental set-up, source mounting, geometrical arrangement, and procedure are the same as described in the authors' earlier paper.³

The observed spectrum of the conversion electrons belonging to the 800 keV transition is shown in Fig. 1 in which they can be seen to be sufficiently resolved from the conversion electrons belonging to the 605 keV transition. Applying the necessary corrections (details in ref. 3) the conversion electron intensity $N_e = a_e X_e Y_e f_{\gamma} f_{\beta} f_{\alpha} f_{\beta} = 24.26 \times 10^3$ per min., where the observed line area $a_e = 9.8$ cm.², $X_e = 2$ volts/cm., $Y_e = 500$ counts/5 min./cm., the factor for geometry $f_{\gamma} = 1$, the factor for window

absorption $f_{\alpha} = 1$ and the factor for the phosphor back-scattering of electrons $f_{\beta} = 1.238$. The error in this intensity estimate is 6%.

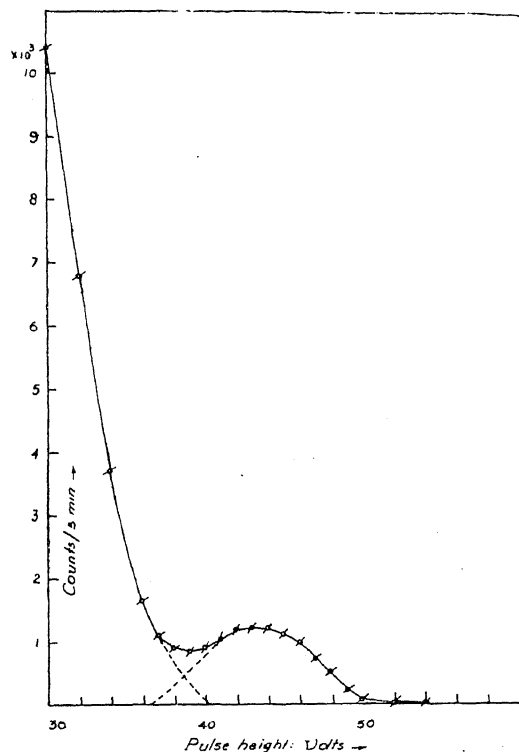


FIG. 1

The gamma spectra are obtained employing external converter foils of Au I (14.8 mg./cm.²), Au II (29.6 mg./cm.²) and Ta (17.46 mg./cm.²) having the same dia. 1.04 cm. The spectra obtained with Au II and with its Compton-equivalent Al target are shown in Fig. 2. The resulting photoelectron spectrum is shown in Fig. 3. The photoelectron line due to the 800 keV transition is isolated from that due to the 605 keV transition, by a smooth extrapolation of the latter at its high energy edge. The area of the photo line, a_p , is measured and the gamma intensity $N_{\gamma} = a_p x_p g_p f_{\alpha 1} f_{\alpha 2} f_{\beta 1} f_{\beta 2} / \sigma N$ is obtained. The data are presented in Table I. The factors $x_p = 2$ volts/cm., $y_p = 100$ counts/20 min./cm., the factor for the absorption of gammas in the Al beta stopper $f_{\alpha 1} = 1.034$ and the factor for the angular distribution of photoelectrons $f_{\alpha 2} = 1.003$ are common for the 3

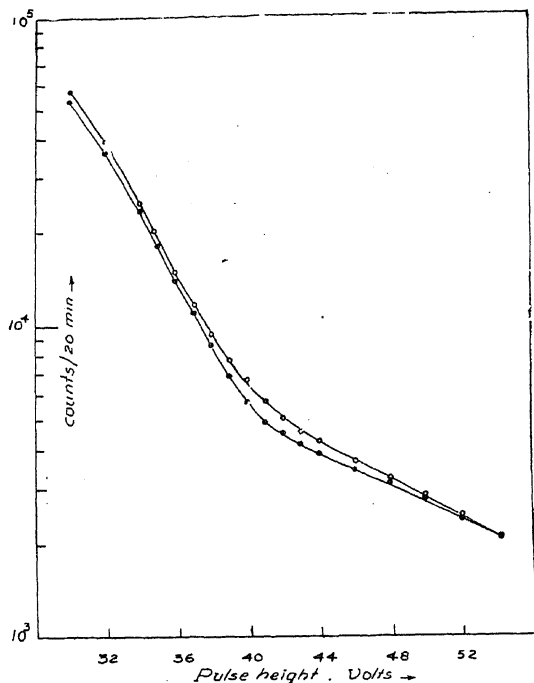


FIG. 2

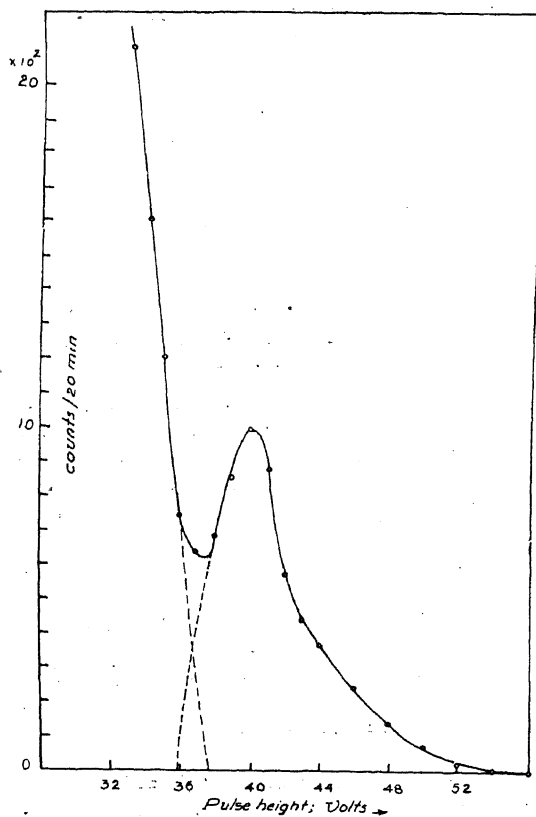


FIG. 3

readings in the table. The photoelectric cross-section σ is obtained from published tables.⁴ N is the number of atoms in the converter foil. The error in the N_γ measurement is $\sim 7\%$.

TABLE I
Gamma-ray intensity data

Con- verter foil	Photo- line area (a_p cm ²)	f_{sa}	f_{pb}	σ bn/ atom	Gamma intensity $N_\gamma/\text{min.}$	Total ICC $\alpha \times 10^3$
Au I	16.2	1.03	1.239	8.1	6.905×10^5	3.514
Au II	32.6	1.06	1.239	9.1	7.343×10^5	3.304
Ta	14.8	1.03	1.238	5.08	7.028×10^5	3.452
						3.423 ± 0.062

The average value of the total conversion coefficient $\alpha = N_c/N_\gamma$ as noted in the table along with std. dev. is $(3.423 \pm 0.062) \times 10^{-3}$. A value of $(3.382 \pm 0.072) \times 10^{-3}$ for α , consistent with the above one, has been obtained on repeating the entire experiment. The overall error in α is 10%. Taking⁵ $K/L = 7$, the K-conversion coefficient α_K is deduced and the values are shown in Table II along with the theoretical

TABLE II
Results on K-conversion coefficient

Present values	Theoretical ^{6,7}	Other experimental values
$\alpha_K \times 10^3$	$\alpha_K \times 10^3$	$\alpha_K \times 10^3$
2.87 ± 0.29	2.6 (E2)	2.1 ± 0.2^s
2.84 ± 0.29	2.6 (E2)	2.6 ± 0.3^1
		2.46 ± 0.3 (706 keV) ²
		2.57 ± 0.4 (802 keV) ²

and other experimental values. The agreement confirms the E2 nature of the radiation.

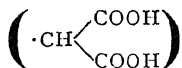
The authors gratefully acknowledge the financial assistance from the Department of Atomic Energy, Government of India.

Laboratories for Nuclear Res., M. RAJA RAO.
Andhra University, S. JNANANANDA.
Waltair, May 10, 1966.

1. Trehan, P. N., French, J. D. and Goodrich, M., *Phys. Rev.*, 1963, **131**, 2625.
2. Brown, R. A. and Ewan, G. T., *Nucl. Phys.*, 1965, **68**, 325.
3. Raja Rao, M. and Jnanananda, S., *Nucl. Instr. and Metho's*, 1965, **36**, 261.
4. Grodstein, G. W., *N.B.S. Circ. No. 583*, 1953.
5. Keister, G. L., Lee, E. and Schmidt, F., *Phys. Rev.*, 1955, **97**, 451.
6. Rose, M. E., *Internal Conversion Coefficients*, N.-H.P.C., 1958.
7. Sliv, L. A. and Band, I. M., *Alpha-Beta-Gamma-ray Spectroscopy*, N.-H.P.C., Appendix V, 1965.
8. Schmidt, F. and Keister, G. L., *Phys. Rev.*, 1952, **86**, 632.

CERIC ION—MALONIC ACID REDOX SYSTEM FOR AQUEOUS VINYL POLYMERISATION

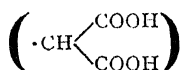
THE Redox system ceric ion-alcohol¹ or aldehyde² as reducing agent was employed in vinyl polymerisation in aqueous sulphuric acid or perchloric acid medium. The studies³⁻⁴ on oxidation of Malonic acid (A), by ceric ion in sulphuric acid medium assumed formation of radicals



which were further oxidised by Ce^{+4} to formic acid as the end product. Our studies on thermal polymerisation of methylacrylate (MA), or methylmethacrylate (MMA) at 15°C in sulphuric acid medium by the redox system, ceric ammonium sulphate-malonic acid, revealed certain interesting features which are described here.

The polymerisation experiments were carried out in dark and under deaerated conditions (under nitrogen), at constant hydrogen ion concentration, $[\text{H}^+] = 0.5 \text{ M}$; ionic strength ($\mu = 0.6 \text{ M}$), and $[\text{Ce}^{+4}] = [\text{A}] = 1 \times 10^{-4} \text{ M}$ to $5 \times 10^{-3} \text{ M}$, $[\text{MMA}] = 0.05$ to 0.12 M , and $[\text{MA}] = 0.1$ to 0.52 M . The following were some of the salient observations made: There was no inhibition period. The steady state was achieved in 2-5 minutes. The rate of monomer disappearance ($-d[\text{M}]/dt$) was followed by gravimetry and that of ceric ion ($-d[\text{ceric}]/dt$) by titrimetry.⁵ The chain lengths (n) were measured viscometrically in benzene for P-MMA⁶ and in acetone for P-MA.⁷

Our results lead us to the following conclusions: (i) Production of hydroxyl radical from water oxidation by ceric and direct reaction of the monomer with ceric are unimportant as initiation reactions; (ii) The reaction ceric ion + malonic acid produces the free radical



which may partly be oxidised by Ce^{+4} to give the products and partly reacts with the monomer initiating polymerisation; (iii) The growing polymer chains get terminated by the mutual type and not the expected linear type (with the ceric ion). The dependence of $-d[\text{M}]/dt$ on $[\text{M}]^{3/2}$ (under conditions ($k_0 [\text{Ce}^{+4}] \gg k_t [\text{M}]$) and on $[\text{Ce}^{+4}]^{\frac{1}{2}}$, and $[\text{A}]^{\frac{1}{2}}$ (in the range $1 \times 10^{-4} \text{ M}$ to $2 \times 10^{-3} \text{ M}$) give weight to the mutual type of termination.

Assuming the usual stationary state kinetics for free radicals, the following rate expressions are obtained:

$$- \frac{d[\text{M}]}{dt} = k_p \left\{ \frac{k_r k_i [\text{Ce}^{+4}] [\text{A}]}{k_t (k_i [\text{M}] + k_0 [\text{Ce}^{+4}])} \right\}^{1/2} [\text{M}]^{3/2}$$

$$- \frac{d[\text{Ceric}]}{dt} = k_r [\text{Ceric}] [\text{Malonic acid}]$$

$$n = k_p \left\{ \frac{[\text{M}] (k_i [\text{M}] + k_0 [\text{Ce}^{+4}])}{k_t k_i k_r [\text{Ce}^{+4}] [\text{A}]} \right\}^{1/2}$$

By titration of the ($-\text{COOH}$) groups in the polymer, the molecular weight of the P-MMA calculated on the basis of mutual termination is $\sim 11,500$, which is in fair agreement with number average molecular weight $\sim 10,000$.

The values of the composite constant $k_p (k_i/k_t k_r)^{\frac{1}{2}}$ evaluated from plots of $-d[\text{M}]/dt$ as well as $-d[\text{Ceric}]/dt$ against various variables are 0.109 for MMA and 0.237 for MA.

Dept. of Physical Chemistry, S. V. SUBRAMANIAN.
University of Madras, M. SANTAPPA.
Madras-25, April 23, 1966.

1. Katai, A. A., Kulshrestha, V. K. and Marchessault, R. H., *J. Polymer Sci.*, Part C, 1963, No. 2, p 403.
2. Santappa, M. and Ananthanarayanan, V. S., *Proc. Ind. Acad. Sci.*, 1965, 62, 150.
3. Sengupta, K. K. and Aditya, S., *Z. Physic. Chem. Neue Folge.*, 1963, 38, (1/2).
4. Yadav, R. L. and Bhagwat, W. V., *J.I.C.S.*, 1964, 41, No. 5.
5. Ananthanarayanan, V. S. and Santappa, M., *J. Polymer Sci.*, 1965, 9, 2437.
6. Baxendale, J. H., Bywater, S. and Evans, M. G., *Ibid.*, 1946, 1, 237.
7. Fuhrman, M. and Mesrobian, R. B., *J. Am. Chem. Soc.*, 1954, 76, 3281.

CHEMICAL EXAMINATION OF THE BARKS OF *DELONIX ELATA* AND *D. REGIA*

Delonix elata Gamble (syn. *Poinciana elata* Linn.) and *Delonix regia* Rafn. (syn. *Potnciana regia* Bojer ex Hook.) (Family: Leguminosae) are two common trees grown in most tropical countries, especially in avenues. The former is recorded to have therapeutic value, in Indian indigenous system of medicine, for rheumatism and in fevers; the latter is strikingly ornamental.¹ The flowers of *D. elata* were found to contain isouercitrin² and those of *D. regia* cyanidin diglycoside, kempferol and quercetin^{3,4} and carotenoids.⁵ A comparative study of the chemical components of the barks of these two trees is now reported.

Thin peels of the fresh trunk bark of *D. elata* were extracted with cold methanol and the concentrate, after removal of the fatty material

with ether, was saturated with ether and kept in the ice-chest. Colourless crystalline solid, decomp. 243–45° (methanol-water); yield, 0.8%. This substance was identified as L (–) asparagine by analysis, optical rotation, i.r. spectrum, paper chromatography and comparison with an authentic sample. The mother liquor after removal of the asparagine contained a small amount of free aspartic acid. The extract did not give any positive test for flavonoids.

Coarsely powdered bark of *D. regia* was extracted with cold acetone and from the dark red concentrate the waxes were removed with petroleum ether and ether. Further extraction with ethyl acetate yielded leucocyanidin which was identified by conversion to cyanidin chloride; the identity of the latter was confirmed by light absorption, paper chromatography and comparison with an authentic specimen.⁶ The bark powder, after acetone extraction, was extracted with cold alcohol and the extract worked up as in the case of *D. elata*. A semi-solid residue was obtained which gave a positive ninhydrin reaction, but no crystalline substance could be isolated.

It is interesting to note that the bark of *D. elata* contains asparagine but no leucocyanidin while that of *D. regia* contains leucocyanidin but no asparagine. This fact is important from the point of view of chemotaxonomy.⁷ Recent work has shown that the biosynthesis of asparagine involves the utilization of cyanide⁸ and the present finding that asparagine is present in good amounts in the bark of *D. elata* but not in the bark of *D. regia* suggests that there might be some fundamental differences in cyanide metabolism in the two species.

The authors wish to express their gratitude to Professor T. R. Seshadri, F.R.S., for his kind interest in this study.

Dept. of Chemistry, S. SANKARA SUBRAMANIAN.
Jawaharlal Institute of

Post-graduate Medical
Education and Research,
Pondicherry-6,

and

Dept. of Chemistry, A. MALHOTRA.
Delhi University, V. V. S. MURTI.
Delhi-7, March 1, 1966.

1. *The Wealth of India—Raw Materials*, C.S.I.R. (India), New Delhi, 1952, 3, 29.
2. Subramanian, S. S. and Swamy, M. N., *Curr. Sci.*, 1963, 32, 308.
3. Pankajamani, K. S. and Seshadri, T. R., *J. Sci. Industr. Res.*, 1955, 14B, 93.
4. Ponniah, L. and Seshadri, T. R., *Ibid.*, 1953, 12B, 605.

5. Jungalwala, F. B. and Cama, H. R., *Biochem. J.*, 1962, 85, 1.
6. Ganguly, A. K. and Seshadri, T. R., *Tetrahedron*, 1959, 6, 21.
7. Swain, T. (Editor), *Chemical Plant Taxonomy*, Academic Press, London, 1963.
8. Ressler, C., *Federation Proc.*, 1964, 23, Part 1, 1350.

THE NATURE OF ATROPINE ANTAGONISM TO ARECOLINE ON RAT ILEUM

IN the course of our studies on the central and peripheral effects of *Areca catechu*¹ it was observed that certain pharmacological actions of arecoline, considered to be a parasymphathomimetic drug, varied from those of acetylcholine. Hence investigations were undertaken to elucidate the nature of arecoline action.

Arecoline, the main alkaloidal component of *Areca catechu* exhibits muscarinic actions of acetylcholine though it has no structural similarities with either of them.² This would indicate that probably the receptors on which arecoline acts are likely to be different from those of acetylcholine, in spite of the similarity of final effect. This hypothesis was investigated by a study of the influence of a competitive antagonist of acetylcholine on the spasmogenic activity of arecoline.

MATERIALS AND METHODS

Rat ileum, suspended in Tyrode solution, maintained at 35°C. and continuously aerated was the test organ used. Isotonic contractions were recorded on the smoked drum.

Technique used was one described by Ariens.³ The concentration of the compound in the bath fluid was doubled, redoubled and again redoubled by adding the quantities of the drug necessary without changing the bath fluid but allowing a certain interval of time, enough to permit establishment of equilibrium before the next dose is added. The procedure is ended when no increase or decrease in the response was observed with the addition of the drug.

Maximal contractions of the organ, by adding high doses of arecoline to the bath, was obtained 2–3 times prior to starting the dose-response study, as this results in a greater constancy of reaction.

Atropine, which is a competitive inhibitor of acetylcholine was the antagonist used. Arecoline contractions in the absence and in presence of varying concentrations of atropine were obtained.

RESULTS

The results are represented as cumulative log-dose response curves in Fig. 1.

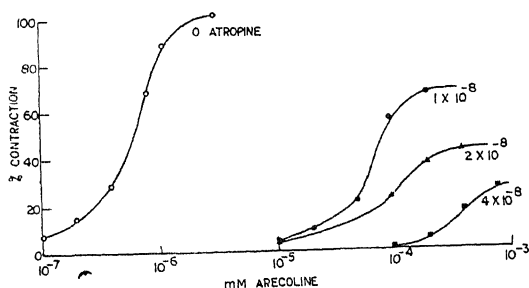


FIG. 1. Cumulative log concentration response curves for arecoline in presence of atropine.

A gradual decline and disappearance of the effect of arecoline at high concentrations of atropine and the decrease in the maximum height and slope of the curves can be seen in the figure. A shift in the curves is also observed.

DISCUSSION

Atropine appears to be a non-competitive antagonist to arecoline on rat ileum, since the degree of antagonism is determined by the concentration of the antagonist only and the antagonistic action is insurmountable.

This type of curve may also be obtained when the specific receptors for the agonist are occupied in an irreversible way by the antagonist. Since the antagonist atropine in this case can be easily washed away from the tissues the irreversible blockade can be eliminated.

Drugs of high intrinsic activity occasionally exhibit the shift in the dose response curves, due to the 'receptor reserves'. The shift seen with arecoline in presence of atropine is more likely, a consequence of this receptor reserve since the shift of the curves is not parallel in presence of increasing doses of atropine. The absence of parallel shifts in the curves is also indicative of the reaction being not of a competitive type.

This non-competitive interaction by atropine reveals that on the rat ileum, the mode of action of the cholinomimetic arecoline is different from that of acetylcholine, the parasympathetic neurotransmitter.

Pharmacology Laboratory,
Indian Institute of Science,
Bangalore-12, April 7, 1966.

M. SIRSI.

1. Sirsi, M., Miss Lalitha Kumari, H. and Jayaraman, H. N., "Central and peripheral effects of *A. catechu*," presented at the Symposium on C.N.S. Drugs, 1965, Hyderabad (under publication).
2. Goodman, L. S. and Gilman, A., *The Pharmacological Basis of Therapeutics*, 2nd Ed., MacMillan & Co., 1955.
3. *Molecular Pharmacology*, edited by Ariens, E. J., Academic Press, London, 1964, p. 143.

THE TRANSFERENCE OF SOLASODINE FROM *SOLANUM INCANUM* TO *S. MELONGENA*

THE non-tuberous species of *Solanum* have come into prominence as a source of steroid hormones in recent years. There are 20 species of *Solanum* growing wild in India. Of these, 9 species from Jammu were analysed by Chopra *et al.* (1963). They have found that of these *S. incanum* had 1.8%, the highest percentage, of solasodine for wild *Solanums* of India. *S. melongena*, the brinjal, which has many varieties and is extensively cultivated in India had only traces of solasodine.

Solanum melongena hybridizes freely with *S. incanum* (Bhaduri, 1951) a cross between *S. incanum* and *S. melongena* (Pusa Purple) was made at the Regional Research Laboratory, Jammu. The F_1 hybrids were more prolific in fruit bearing than either of the parents. While the parent brinjal produced only 46 fruits and *S. incanum* 104, the number of fruits produced by the hybrid was 214. They were completely fertile. When analysed they were found to contain 0.5% solasodine. Thus it was found that solasodine could be transferred from *S. incanum* to *S. melongena*.

F_2 plants showed segregation of both *melongena* and *incanum* characters. Of 100 F_2 plants one which had fruits of the same size as the *S. melongena* was found to have 97% solasodine. The possibility of utilizing this hybrid for solasodine production by further selection and back-crossing is underway.

I wish to thank Dr. E. K. Janaki Ammal under whose guidance this work was carried out. My thanks are also due to Dr. K. Ganapathi, Director, for providing facilities for work.

Regional Research Laboratory, USHA ZUTSHI,
Jammu, March 25, 1966.

1. Ghopra, I. C., Vishwapaul and Handa, K. L., *Nagarjun*, 1963.
2. Bhaduri, P. N., *Indian J. of Genet.*, 1951, 11, 75.

CATION EXCHANGERS FROM SOUTH ARCOT LIGNITE

CERTAIN coals and lignites are known to be natural, weak acid cation exchangers widely used in water treatment after converting them into strong acid cation exchangers by sulphonation with fuming sulphuric acid. South Arcot lignite, though by itself is not a very good cation exchanger, could be converted into a good cation exchanger by sulphonation. Using measured quantity of fuming sulphuric acid and keeping bath temperature at $90^\circ \text{C} \pm 5$,

it was possible to sulphonate satisfactorily South Arcot lignite. After sulphonation, the material was washed thoroughly free from acid and dried at 100° C. for two hours.

For testing the efficiency of the exchanger thus prepared, water containing a total hardness of 50 ppm was passed through a column of 10 cm. in height and 5 cm. diameter containing the prepared exchanger. The rate of flow was 8 litres per hour. The effects of the following factors were studied during this investigation:

1. Particle size of lignite.
2. Duration of sulphonation.
3. Quantity of fuming sulphuric acid required for complete sulphonation.
4. Regeneration of the spent ion exchanger.

Four different sizes of lignite, viz., - 2.812 mm. + 2.057 mm., - 2.057 mm. + 1.676 mm., - 1.676 mm. + 1.405 mm., - 1.405 mm. + 1.204 mm., were used. Within the range of investigations conducted particle size had no effect on the efficiency of the ion exchanger. Sulphonation was done for 16, 24, 32 and 40 hours. It was found that 32-hour sulphonation was necessary for effective sulphonation of lignite. Beyond this, there was not much effect. Tests indicated that a ratio 2:5 of lignite and fuming sulphuric acid was needed to obtain effective sulphonation.

It was also found that all the conventional regenerating agents such as 2 to 3% sulphuric acid, 10% hydrochloric acid and 5% brine solution were effective as regenerating agents. It was also found that 1% o-phosphoric acid regenerated the spent exchanger effectively. Ion exchanger was repeatedly used and repeatedly regenerated, and it was found that the regenerated ion exchanger was quite active. The regeneration was carried out by passing 5 litres of any of these regenerating agents in the reverse direction.

Table I gives the analysis of water before and after treatment with the lignite exchanger.

TABLE I

Constituents	Before Treatment	After Treatment
Silica, SiO ₂ (ppm)	86.42	86.24
Mixed Oxides R ₂ O ₃ (ppm)	1.20	1.00
Total hardness (ppm)	45.50	
Hardness due to calcium (ppm)	26.00	
Hardness due to magnesium (ppm)	19.50	
pH	5.96	

The authors thank the authorities of the Neyveli Lignite Corporation for granting permission to publish these results.

Central Laboratory,
Neyveli Lignite
Corporation Limited,
Neyveli, March 30, 1966.

N. K. SARMA.
B. C. KOSHY.
D. N. SIBAL.*
C. V. S. RATNAM.

* At present working as Assistant Chief Chemist in the Bokaro Steel Project, Bokaro.

OCCURRENCE OF NORITIC ROCK AT KOILAPAHAR, MIKIR HILLS, ASSAM

THE area, between Lat. 25° 58' 0" N and 26° 2' 30" N and Long. 93° 30' 5" E and 93° 37' 0" E, covered by toposheet Nos. 83 G/9 and 83 F/12, around Koilapahar in the south-eastern spurs of Mikir Hills, Assam, presents a variety of rock types which can broadly be grouped into two divisions—igneous and sedimentary. The igneous rocks include Precambrian granite and granite gneisses and Jurassic trap rock (locally known as the Sylhet trap), while the sedimentary rocks are represented by sandstone, coal, clay and limestone of Tertiary age. The oldest rocks of the area are granite and granite gneisses.

The most interesting feature observed in the area is the presence of a small exposure of Noritic rock, exposed in the cutting of the main Kolajan stream (Lat. 26° 15' 0" N.; Long. 93° 33' 45") about 400 metres south of the Koilajan colliery, covering an area 30 metres by 15 metres. This rock type has not been reported so far from anywhere else in the Mikir Hills. However, Ghosh (1952) has reported the occurrence of similar rock type from the Nongmawait-Rambari-Nongstoin plateau, Khasi Hills, Assam, about 250 km. towards south-west, under the name Pyroxene granulite and Pyroxene-hornblende-granulite. Ghosh has also pointed out that the basic rocks encountered in the Khasi Hills are of the nature of sills and dykes, showing a certain amount of variation in composition (*loc. cit.*). It is a hard compact, medium-grained melanocratic rock showing prominent foliation which dips 50° towards N 50° E. The rock is very well jointed, the three prominent joint planes dipping respectively 55° towards N 25° W; 48° towards S 30° E and nearly vertical.

Puckers are prominent. Though the grain sizes are quite small, yet the constituent minerals seem to indicate a platy nature parallel to the foliation. At places segregation of bigger grains of augite along with some feldspar and quartz are seen. The rock throughout is extremely uniform in composition and character.

Microscopic studies reveal that it is a medium-grained basic rock. Hypersthene and augite are

the main constituent minerals, while diopside and apatite occur as accessory minerals. Some of the basic rock types, reported from the Khasi Hills, are rich in pyroxene while others are characterized by hornblende. Intergrowth of hypersthene with iron-rich diopside are common. Ghosh has opined that in some of the pyroxene-hornblende-granulites, the hypersthene have been formed from the iron-rich diopside (*loc. cit.*). Hypersthene grains are subhedral to anhedral, strongly pleochroic from pale green to pale pinkish-red, optically negative. Inclusions of feldspar, magnetite and quartz in hypersthene are common. Augite is the second important mineral and its grains are highly pleochroic from green to pinkish green (extinction angle 20°), probably titanite-augite. The grains of Labradorite are subhedral with an extinction angle on albite twin 30° . Grains of hornblende are rather rare, yellowish-green in colour, pleochroic, the colours changing from yellowish-green to dark green, extinction angle 18° . Some grains are greenish-brown to reddish-brown in colour. Diopside grains are subhedral, greenish in colour, pleochroic, extinction angle 40° while apatite grains are acicular in form. Grains of magnetite are scattered, they are subhedral to anhedral in form and show metallic lustre in reflected light. Since most of the grains are subhedral, the rock presents a hypidiomorphic texture.

The evidences available, both megascopic and microscopic, suggest an igneous origin of the rock. The rock is definitely younger to the associated granite and granite gneisses.

The author is deeply indebted to Professor R. C. Misra, Head of the Geology Department, University of Lucknow, for helpful criticism and to Sri S. K. Barooah, Director, Geology and Mining, Assam, and Dr. S. C. D. Sah, Birbal Sahni Institute of Palaeobotany, Lucknow, for their interest.

Directorate of Geology
and Mining,
Assam, March 4, 1966.

S. K. DUTTA.

1. Ghosh, A. M. N., *Rec. Geol. Surv. India*, 1952, 82 (1), 311.

OCCURRENCE OF CALCAREOUS OOLITES IN THE KROL SERIES (PERMIAN ?) OF THE SIMLA HILLS

THE authors record the occurrence of calcareous oolites in the Krol beds of the type area—Krol hill (31° N, $77^\circ 5'$ E) of the Simla region—for the first time. The oolitic limestone occurs in the Krol D stage of the Krol Series (Auden, 1934).¹

The lithological succession as seen in the Krol hill is as follows:

	Grey limestone	Krol E
200 m.	Porcellaneous limestone	} Krol D
20 m.	Oolitic limestone	
80 m.	Bluish-grey limestone	Krol C
160 m.	Red Shale	Krol B
280 m.	Calcareous Shale	Krol A
160 m.	Krol Sandstone	
	Infra-Krols—Predominantly dark Shales	

Structurally, the beds are folded in the form of an asymmetrical syncline with WNW-ESE direction. The oolitic limestone is exposed in the southern limb of the syncline.

The rock is light to dark grey in the fresh state showing spherical to ellipsoidal oolites which are well seen with the help of a hand-lens. It weathers to a yellowish product. Under the microscope, it shows isolated oolites cemented by a microcrystalline matrix of calcite and dolomite (Fig. 1). The oolites

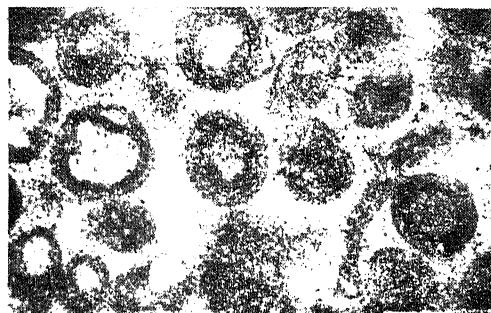


FIG. 1. Photomicrograph showing isolated oolites cemented by carbonate matrix.

constitute 60 to 75% of the volume of the rock and range in size from 0.2 to 0.6 mm. in diameter. Thus the oolitic limestone is a calcarenite.

Each oolite consists of a nucleus surrounded by an envelope. The nucleus, whose size is variable, is composed of cryptocrystalline aggregate of calcite but occasionally detrital grains of quartz, feldspar and oolites of an earlier generation also form the nucleus. The envelope is composed of one or more concentric layers of carbonate.

Micromorphological study reveals that the following types of oolites are present:

1. *Concentric laminated oolites*—Oolites with an envelope of several concentric layers of carbonate round the nucleus. This type is statistically most abundant.
2. *Superficial oolites*—Oolites with an envelope of one or two layers surrounding the nucleus.

3. *Barrel-shaped oolites* (Walzenooide).
4. *Pseudoolites*—Oolites without any superficial envelope.
5. *Composite oolites* or *oolitic sacs* (Ooidbeutel)—These consist of two or more oolites surrounded by a common envelope of carbonate (Fig. 2). The number of individuals in the sacs ranges upto 35.



FIG. 2. Photomicrograph showing an oolitic sac with three individuals. White areas correspond to recrystallised calcite. Nicols not crossed. $\times 36$.

Recrystallisation of the carbonate of the oolites as well as of the matrix into coarser sparry calcite, deformation of the oolites, fracture fillings, stylolitisations and authigenic formation of dolomite, quartz and gypsum include the diagenetic changes recognised in thin sections of the oolitic limestone.

These oolites in the Krol Series may have been formed in a shallow marine (near shore) environment of deposition which is also supported by other sedimentary features.

The authors are thankful to Prof. I. C. Pande for his valuable suggestions.

Department of Geology, A. D. KHARKWAL.
Panjab University, SURENDAR KUMAR.
Chandigarh, March 11, 1966.

1. Auden, J. B., "Geology of the Krol Belt," *Rec. Geol. Surv. Ind.*, 1934, 67, Part IV.

ON THE OCCURRENCE OF VERMICULITES AT PAUNI, BHANDARA DISTRICT

DURING the detailed investigations of the chromite deposits and the associated rocks of Pauni ($20^{\circ} 47' : 79^{\circ} 39'$) in Bhandara District, Maharashtra, in 1964-65, the authors noticed occurrences of vermiculites which are being reported here for the first time from this region.

A sample of the mineral was treated in a furnace to a temperature above 800°C . and the

characteristic exfoliation phenomenon was noticed. The exfoliated flakes were found to be much lighter in weight compared to that of original material. During this treatment, development of golden, bronzy and silvery lustre on the flakes was observed, which is an outstanding characteristic of vermiculites.

Several irregular bodies of vermiculites in the form of lenses, veins and pockets are found associated with the altered ultrabasics and are seen well exposed in the chromite quarries. The vermiculite bodies generally occur near the contact of the acid intrusives with the ultrabasics. The vermiculites are of various shades of brown and are highly flaky and laminated in nature. The individual flakes are rather small in size and exhibit silky sheen under normal light. The dark brown colour of the mineral could be attributed to the high amount of ferruginous matter present. Small grains of quartz are found embedded within the laminae.

Vermiculite is formed as an alteration product of biotite or phlogopite by weathering or hydrothermal action, and are often found along the contact zone of acid intrusives and basic and ultrabasic rocks such as dunite, pyroxenites, peridotites, etc. The vermiculite deposits of Hafafit (Egypt) occurring near the contact of pegmatite and serpentines are considered to be of hydrothermal origin by Amin and Afia (1954). The Day Book vermiculite deposits, Yancy Country, North Carolina (USA), occur in altered dunites which have been intruded by pegmatites (Kulp and Brobst, 1954). These are considered to be a weathered product of phlogopite formed by hydrothermal changes.

In the area under consideration, both basic and ultrabasic rocks have been found to be intruded by number of pegmatite bodies. The ultrabasics have been hydrothermally altered to various rock types containing talc, tremolite, serpentine, chlorite, anthophyllite, etc. (Nair and Singh, 1966). From the nature of occurrence and their associations it appears that vermiculites of Pauni are genetically related to hydrothermal changes caused by the intrusions of pegmatitic bodies in the ultrabasics.

The reserves of vermiculites in the area seem to be quite promising and the exploitation will be easy considering their association with the workable chromite deposits. In view of the industrial importance of vermiculites work is being continued on these deposits.

We wish to acknowledge the encouragement received from Dr. R. S. Mithal, Professor and Head of the Department of Geology and Geophysics. Thanks are due to Dr. V. S. Rama-

chandran of the C.B.R.I. for the help rendered during the laboratory investigation. The junior author (N. G. K. N.) is indebted to the C.S.I.R. for financial assistance.

Dept. of Geology and
Geophysics,
University of Roorkee,
Roorkee (U.P.), March 8, 1966.

N. G. K. NAIR.
K. K. SINGH.

1. Amin, M. Sc. and Afa, M. S., *Econ. Geol.*, 1954, **49**, 317.
2. Kulp, J. L. and Brobst, D. A., *Ibid.*, 1954, **49**, 211.
3. Nair, N. G. K. and Singh, K. K., *Proc. Ind. Sci. Cong. Geol. Sec.*, 1966.

A PAPER CHROMATOGRAPHIC ANALYSIS OF THE ENZYMATIC ACTIVITY IN VITRO

IV. Isolation, Identification, and Estimation of Glutamic Acid as a Product of Liver Histidase Activity

HISTIDINE when reacted with histidase is believed to yield ammonia, formic acid and glutamic acid. However, Walker and Schmidt¹ suggested that the end product of this reaction was α -formamidino glutaric acid. Tauber² states that the end products could not be isolated. The present paper-chromatographic study, using the modified technique,³ aims at isolation, identification and if possible estimation of these end products.

The enzyme histidase was prepared by grinding rat liver tissue with phosphate buffer of pH 8.2, and 1% *l*-histidine solution in glass-distilled water. The control and experimental tubes were prepared and incubated for 3 hours at 38° C. as in our previous study.⁴

Horizontal circular paper chromatography after the method of Giri and Rao² was done. The chromatogram was divided into six sectors (Fig. 1) and spots (0.005 ml.) were placed from control and experimental tubes. Sectors 1, 3 and 4 were spotted with 0.005 ml. from the experimental tube at 0, 2 and 3 hours of incubation periods respectively. The spot of sector 2 consisted of 0.005 ml. of glutamic acid of known strength (0.005 mg./0.01 ml.) besides the contents of control tube, the sectors 5 and 6 were spotted with identical quantities and strengths of glutamic acid and threonine, the two overlapping amino-acids.

The chromatogram thus prepared was run for 10-12 hours using *n*-butanol : acetic acid : water (4 : 1 : 5) as the solvent. After drying, the sectors 2 and 5 were partially cut away from the neighbouring sectors and stained with 0.5% ninhydrine in 95% acetone to serve as

guide sectors for marking the position of glutamic acid bands on the untreated sectors. The corresponding unstained portions of sectors 1, 3, 4 and 6 were cut out and used as wicks for the separation of glutamic acid and other overlapping amino-acids, if any, by the modi-

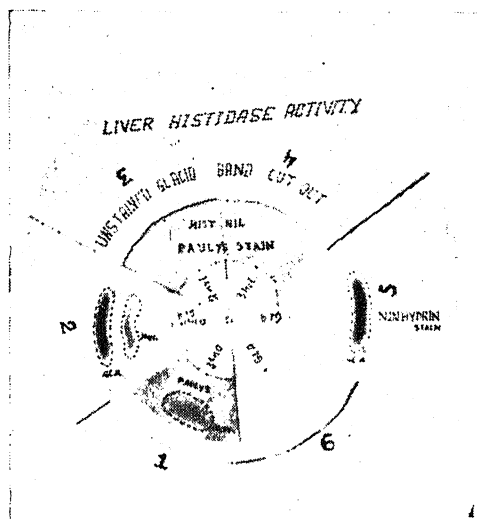


FIG. 1

fied technique (*loc. cit.*). The proximal parts of the sectors 1, 3 and 4 were then stained with Pauly's reagent, specific for histidine, to confirm the complete breakdown of histidine by 2 hours of incubation with the enzyme. The unstained cut-out bands were stitched to the one inch wide strip of chromatography paper which could be fastened to the frame even by cotton threads instead of using silver wire springs mentioned in the modified technique (*loc. cit.*). The sector 6 unstained band served as control wick for the strip chromatograms. These strip chromatograms were run with pyridine : water (8 : 2) as solvent for 8 hours and stained with ninhydrine. The glutamic acid band was clearly identified at 2-hour incubation as seen in Fig. 2. The similarly

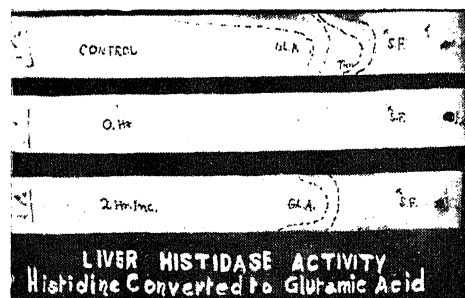


FIG. 2

developed and stained band of glutamic acid after 3 hours of incubation period from sector 4 was cut out and eluted in 4 ml. distilled water in a test-tube immersed in water-bath at 50° C. for 15 minutes. The colour densities of the control glutamic acid and the above strip were measured at 400 m μ wavelength on a Coleman Junior spectrophotometer.

Hence the only chromatographically identifiable band of breakdown products of histidine by histidase is that of the glutamic acid. On calculation it is seen that the glutamic acid obtained from histidine breakdown does not fully account for the mole-per-mole mathematical relationship expressed by Fruton.¹

Department of Anatomy,
G.R. Medical College,
Gwalior, March 21, 1966.

V. A. SHINDE.
R. K. JAIN.
I. P. AGARWAL.

1. Fruton, J. S. and Simmonds, S., *General Biochemistry*, John Wiley & Sons, Inc. New York, 2nd ed., 1958, p. 821.
2. Giri, K. V. and Rao, N. A. N., *Jour. Indian Inst. Sci.*, 1953, 35 (4), 343.
3. Shinde, V. A., Agarwal, I. P., Verma S. C. L. and Jain, R. K., *Curr. Sci.*, 1963, 32, 118.
4. —, Jain, R. K. and Agarwal, I. P., *J. Anat. Soc. India*, 1965, 14 (1), 1.
5. Tauber, H., *The Chemistry and Technology of Enzymes*, John Wiley & Sons, Inc., New York, 2nd ed., 1950, p. 117.
6. Walker, A. C. and Schmidt, C. L. A., *Arch. Biochem.*, 1944, 5, 445.

PRESERVATION OF *GNETUM* MATERIAL IN NATURAL COLOUR

PLANT collectors always find it difficult to preserve *Gnetum* specimens in good condition. If they are preserved in the normal FAA solution experience shows that they turn dark soon after bottling and the preservative too gradually becomes a dark decoction.

However, I found the following technique to be satisfactory for preservation of *Gnetum* material in almost natural colour. Freshly collected specimens of *Gnetum*—thin stems, leaves, cones—are first water-cleaned and then air-dried. The material is then kept in pure glycerine for about three to four days and then is bottled in castor oil after removing the extra glycerine by gently pressing the material between blotters. Material preserved in this way in January 1963 has not so far turned dark. This preserved material can be used for morphological as well as anatomical studies. Hand-cut sections are treated first with petroleum ether to get rid of the oil present. Then the usual technique of double staining with saffranin and

light green is followed. It is to be noted that instead of aqueous stain, saffranin in 50% alcohol is to be used. Later steps remain the same.

For microtome sections, pieces of the material preserved by the above technique are kept in petroleum ether for a few hours to remove oil. Then the usual process for preparing paraffin blocks is followed.

Institute of Science, S. D. CHITALEY.
Bombay-1, March 15, 1966.

SELECTIVE CONTROL OF *LORANTHUS* ON TEAK

Loranthus spp., the parasitic weed on many horticultural plants, have been observed to be prolifically growing on the valuable timber yielding teak tree (*Tectona grandis*) in several forest ranges of Malabar. Parasitic growth of this weed reduces the timber yield of teak if not kills the tree ultimately. Since mechanical removal of this weed is laborious, time-consuming and uneconomical, preliminary experiments on the selective herbicidal control of *Loranthus* on teak were conducted. Chlorophenoxy, triazine and urea type of hormone herbicidal formulations were employed. However, the chemical 1 : 1-dimethyl 4 : 4-bipyridylum has been observed to be more efficacious and suitable. The critical time for the spray application of this chemical for the herbicidal destruction of *Loranthus* is observed to be early summer when the teak tree is devoid of its foliage. No residual toxicity of the chemical was noticed. It was not absorbed through non-chlorophyllous parts of tree and was washed off by the rain when it got inactivated on contact with soil.

University Department of Botany, K. GEORGE.
Devagiri, Calicut, September 4, 1965.

A CONTRIBUTION TO THE STOMATAL STUDY OF *MARSILEA MINUTA* LINN.

GUPTA¹ investigated the epidermal features of some American *Marsileas*, which proved to be of some diagnostic value. He has also investigated the epidermis of some Indian species of *Marsilea* including *M. minuta* Linn.²

During the course of an ecological and morphological study of *Marsilea minuta* Linn. growing locally, I also investigated the stomatal characters of its three life forms, viz., (1) water form with floating leaves; (2) water form with immersed leaves; and (3) terrestrial form inhabiting drier habitat.

TABLE I
The stomatal characters of *M. minuta* Linn.

* Life form	Average size of stomata in μ		Frequency of stomata (per sq. mm.)			Wall of epidermal cells	
	Upper surface	Lower surface	Upper surface	Lower surface	Total of upper and lower surfaces	Upper surface	Lower surface
(1)	28 \times 20	Absent	204	—	204	Slightly sinuous	Slightly sinuous
(2)	30 \times 18	30 \times 18	162	108	270	"	"
(3)	26.5 \times 16.5	26.5 \times 17	180	216	396	"	"

* Numbers referred to the life forms are enumerated above in the text.

The stomata in *M. minuta*, recorded here, are much larger than those recorded by Gupta¹ where they vary from $8.9 \times 5.4 \mu$ to $14.2 \times 7.6 \mu$; while the variation in the stomatal size in my specimens ranges from $26.5 \times 16.5 \mu$ to $30 \times 18 \mu$. Accompanying the size variation the stomatal frequency also varies. Gupta's observations place it between 22 and 44 (total of the lower and upper epidermis); while in the present investigation I find it between 204 and 396 stomata per sq. mm.; which is about 9 times greater than the frequency reported by Gupta.

Among the three life forms described here there is only a slight variation in the size of the stomata; but the frequency variation is noteworthy. The frequency increases as one encounters plants of drier habitat. No stomata could be seen on the lower surface of floating leaves of water form; but the frequency of stomata on the lower surface of the plants inhabiting drier habitat is higher than that on the upper surface. The epidermal cells seem to be slightly narrower in terrestrial form inhabiting drier habitats than in those of water form.

The author is indebted to Dr. B. S. Trivedi for his guidance.

Dept. of Botany, PRAKASH CHANDRA SHARMA.
Uni. of Lucknow,
Lucknow (India),
February 5, 1966.

A NOTE ON INDUCED TETRAPLOIDY IN GRAPE

RECENTLY considerable interest has been taken in our country in viticulture on commercial lines. The industry is interested to have large-sized seedless quality grapes both for table and raisin purpose. Inducing tetraploidy may not only increase the berry size but also can help in evolving new triploid seedless grapes by crossing diploids with induced tetraploids. The successful production of colchipsoid grapes by Derman¹ in America and some other workers in Europe and the release of tetra Niabell and Early Niabell in U.S.A. as a result of breeding and selection at tetraploid level by Olmo and Koyama² are very encouraging. The present investigation was therefore carried out at the Indian Agricultural Research Institute, over a period of three years and tetraploidy has been successfully induced in 11 grape varieties.

Of the four different methods, viz., seed, seedling, axillary bud and shoot immersion, seedling and axillary bud treatments were found to be effective. Application of 0.2% colchicine solution by cotton soaking on seedlings at cotyledonary stage on alternate days between 7 a.m. and 12 Noon for three days produced tetraploids in Bhokri and Bharat Early varieties. A maximum of 20% tetraploids were isolated in Bhokri by the seedling treatment method. In the treatment of axillary buds, both 0.25 and 0.50% colchicine in 5% glycerine, to which triton at the rate of 1 drop in 1000 ml. of solution was added, gave best results in Bharat Early, Pusa Seedless, Gros Colman (Pusa), Black Prince, Beauty Seedless, Kandhari Pearl of Casaba, Madeleine Angevine, Madeleine Royale and Perlette. A maximum of 29.1% tetraploids were recovered in the variety Beauty Seedless. The confirmation of tetraploidy was made by counting the somatic

1. Gupta, K. M., "Some American species of *Marsilea* with special reference to their epidermal and soral characters," *Madrono*, 1957, 14, 113.

2. —, *Botanical Monograph No. 2: Marsilea*, Council of Scientific and Industrial Research, New Delhi, 1962.

* Not seen in original.

chromosomes in roots induced by air-layering (Figs. 1 and 2).



FIG. 1. Showing somatic chromosome of diploid Pusa Seedless ($2n=38$).

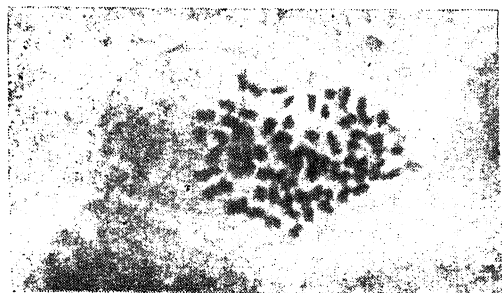


FIG. 2. Showing somatic chromosome of tetraploid Pusa Seedless ($2n=76$).

The changes in morphological characters of the suspected tetraploids provided good indices for detecting chromosome doubling. Most of the affected huds developed chimerical shoots producing sectorial leaf chimeras. Such growths were found to be very useful in forcing total tetraploid growths from the axils of chimerical leaves by repeated cutting back technique of normal unaffected growths. The tetraploids had many diagnostic features like vigorous growth, thick and deep-coloured leaves with increased leaf area and serrations, short and stout internodes, thick petiole and tendrils, etc. These characters were helpful in detecting and isolating tetraploid shoots. Detailed data on morphology and anatomy of confirmed tetraploids showed greater plant parts and bigger cell size than their diploid counterparts. As the tetraploids have not come to flowering and fruiting yet the internal tetraploidy of the material has been determined not only by the somatic chromosome counts but also by increased cell size in inner germinal layers. The plants are under observation and the subsequent results will be reported in due course.

Division of Horticulture, P. K. DAS.
Indian Agricultural S. K. MUKHERJEE.
Research Institute,
New Delhi (India), March 16, 1966.

1. Derman, H. "Colchicoidy in grapes," *J. Hered.*, 1954, 45 (4), 159.
2. Olmo, H. P. and Koyama, A., "Niabell and Early Niabell—new tetraploid varieties of the concond type," *Calif. Agri. Expt. Sta. Bull. No. 790*, 1962.

A NOTE ON *HELMINTHOSPORIUM* *ROSTRATUM* DRECHS. ON RAGI [*ELEUSINE CORACANA* (L.) GAERTN.]

DURING the course of field inspection in the culture collection of millets, a severe leaf blighting in certain varieties of ragi, namely, Banswara local, Nagli 16 and Nagli E. 31, was noticed. On scraping the leaf material from lesions in a drop of water, numerous conidia of *Helminthosporium rostratum* were observed in each case. Occurrence of this fungus on ragi appears to be the first record in literature. Lesions are small, 2–5 × 1–2 mm. vein delimited, straw-coloured with brown edges turning almost to black; conidiophores dark, olivaceous, emerging singly or in groups of 2 to 5, bases sometimes slightly swollen, 40–180 × 6–8 μ , septate; conidia when mature dark, olivaceous, straight or less frequently somewhat curved, often short, widest at or below the middle, tapering moderately or markedly towards both ends, apex being round, the basal end a little more acute, often exhibiting a round conical contour, but often strongly rostrate at the tip, many spores almost oblancoolate, hilum protruding and prominent, 8–24-septate, but elliptical spores only 5- to 9-septate, basal septum and apical or distal septum often thicker and more prominent than others, peripheral wall thick, spores 30–184 × 13–21 μ (Fig. 1).

Recently, *H. rostratum* was found by Mahendra Pal and D. Suryanarayana (1964) in India on sorghum. Also Young, Lefebvre and Johnson (1947) found this organism on various warm temperature-loving hosts, such as corn, sorghum and pearl millet in the United States. Bunting reported this fungus to occur on corn in the Western parts of Africa (R. Sprague, 1950).

The authors are grateful to Dr. S. P. Raychaudhuri for his encouragement and providing facilities. Thanks are also due to Dr. B. L. Benfro, Pathologist, Rockefeller Foundation, for his keen interest in this work.

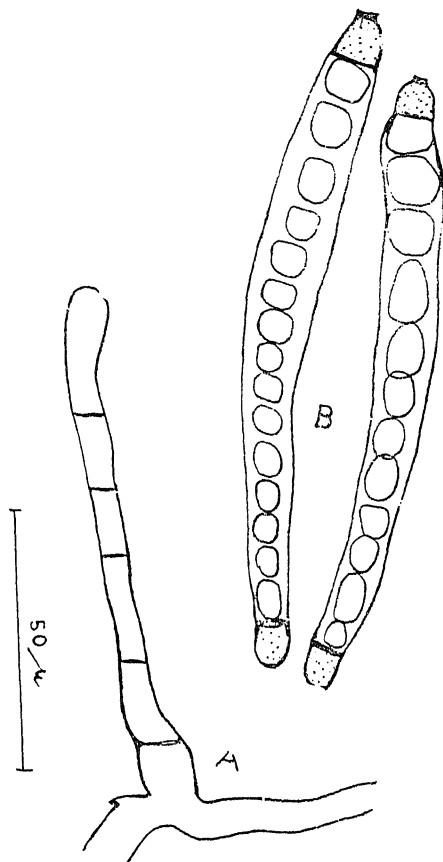


FIG. 1. *Helminthosporium r. stratum*. A. Conidiophore. B. Conidia.

Division of Mycology and
Plant Pathology,
Indian Agricultural
Research Institute,
New Delhi, March 30, 1966.

V. C. LELE.
K. S. DHANRAJ.

SOME NEW HOSTS OF *OIDIOPSIS TAURICA* (LEV.) SALAMON

DURING the months of February and March 1965, powdery mildew on leaves of *Centaurea imperialis* L. and *C. cyanus* L. was observed. The spots were at first angular, amphigenous and later covered the entire leaf surface. Microscopic examination revealed the endophytic mycelium with long slender septate sporophores extruded out of the stomata singly or in fascicles. One-celled conidia are borne singly on the tips of the sporophores. The cleistothecial stage of the fungus was not observed. Different varieties of *Centaurea imperialis* and *C. cyanus* were attacked by this fungus. The average size of conidia on various varieties is given in Table I.

CHART I

Size of conidia on different hosts

Centaurea imperialis

White variety 56.24 (44.0-68.0) × 14.68 (12.0-18.0) μ

Violet variety 58.64 (44.0-72.0) × 14.52 (12.0-18.0) μ

Centaurea cyanus

White variety 53.32 (40.0-68.0) × 14.72 (12.0-18.0) μ

Blue variety 55.32 (44.0-72.0) × 14.70 (12.0-18.0) μ

Violet variety 55.84 (44.0-72.0) × 14.86 (12.0-18.0) μ

The conidia on varieties with coloured flowers are slightly bigger than those on varieties with white flowers. The morphological characters of the fungus are in close conformity with *Oidiopsis taurica* (Lev.) Salamon. The conidial size on different host varieties are within the range reported by Kamat and Patel.¹ *Oidiopsis taurica* on *C. moschata* L. has been reported from Pakistan by Khan.² There is no previous record of this disease on *Centaurea* species from India.

Sincere thanks are due to Dr. R. L. Mathur for going through the manuscript, and to the Director of Agriculture, Rajasthan, Jaipur, for facilities.

Plant Pathology Laboratory, B. L. MATHUR.
Rajasthan, Jaipur, March, 16, 1966.

1. Mahendra Pal and Suryanarayana D., *Indian Phytopath.*, 1964, **17**, 188.
2. Sprague, R., *Diseases of Cereals and Grasses in North America*, The Ronald Press Co., New York, 1950.
3. Young, G. Y., Lefebvre, C. L. and Johnson, A. G., *Phytopathology*, 1947, **37**, 180.

1. Kamat, M. N. and Patel, M. K., *Indian Phytopathology*, 1948, **1**, 153.
2. Khan, S. A., *Biologia*, Lahore, 1959, **5**, 45.

REVIEWS AND NOTICES OF BOOKS

Applied Bessel Functions. By F. E. Relton. (Dover Publications, 180, Varick Street, New York-14, New York), 1965. Pp. vii + 191. Price \$ 1.85.

This Dover edition, first published in 1965, is an unabridged and unaltered republication of the work first published by Blackie and Son Limited in 1946.

The basic properties of Bessel functions, as derived from differential equations, are presented in this book with their applications to mechanics, heat, hydrodynamics and elasticity. The author originally delivered the contents of the book as a series of lectures to British physicists and engineers.

The titles of the chapters contained in this book are as follows: I. The Error Function; Beta and Gamma Functions; II. Differential Equations; The Normal Form; Recurrence Formulæ; Orthogonal Functions; III. Cylinder Functions; Their Recurrence Formulæ and Zeros; IV. Bessel's Equation and the Series Solution; Lommel Integrals; V. Applications to Oscillations; Stability and Transition Curves; VI. The Second Solution for Integral Orders; Further Applications to Oscillations and Heat Conduction; VII. The Modified Functions; Applications to Dynamics and Statics; VIII. Applications to Hydrodynamics and Elasticity; IX. Bessel Coefficients. Integrals and Expansions; and X. Applied Functions Solution of Integrals; Asymptotic Series.

The text assumes that the reader has the mathematical knowledge needed for the usual physics and engineering degree, particularly an elementary knowledge of ordinary differential equations. C. V. R.

Nondestructive Testing (Second Edition). By Warren J. McGonnagle. (Gordon and Breach, Science Publishers, 150, Fifth Avenue, New York-10011), 1966. Pp. 467. Price \$ 25.00.

Nondestructive Testing—the application of physical principles for detecting inhomogeneities in materials without impairing their usefulness—is being called upon more and more to meet the requirements of a rapidly advancing technology. The latest methods and techniques of this growing field are discussed in this book, with emphasis on the advantages, disadvantages, and limitations of each. Originated as a textbook for the beginning student and technician

in the field, *Nondestructive Testing* offers a thorough discussion of: Visual Testing; Pressure and Leak Testing; Liquid Penetrant Inspection; Thermal Methods; X-ray Radiography; Gamma Radiography; Ultrasonics; Dynamic Testing; Magnetic Methods; Electrical Methods; Eddy Current Methods; Thickness Measurements. C. V. R.

Advances in Insect Physiology (Vol. 3). Edited by J. W. L. Beament, J. E. Treherne and V. B. Wigglesworth. (Academic Press, New York and London), 1966. Pp. x + 382. Price 80 sh.

Volume 3 of this well-known series contains the following articles: 1. Image Formation and Sensory Transmission in the Compound Eye, by E. T. Burt and W. T. Catton; 2. Amino-Acid and Protein Metabolism in Insect Development, by P. S. Chen; 3. Metabolic Control Mechanisms in Insects, by W. R. Harvey and J. A. Haskell; 4. The Control of Polymorphism in Aphids, by A. D. Lees; 5. The Regulation of Breathing in Insects, by P. L. Miller. C. V. R.

International Review of Experimental Pathology (Vol. 4). Edited by G. W. Richter and M. A. Epstein. (Academic Press, New York and London), 1965. Pp. ix + 342. Price \$ 14.50.

The scope of this volume is indicated by the titles of the chapters contained therein: 1. Recent Advances Correlating Structure and Function in Mitochondria, by D. F. Parsons; 2. Ultrastructural Cytochemistry: Principles, Limitations, and Applications, by Dante G. Scarpelli and Norbert M. Kanczak; 3. Cellular Necrosis in the Liver Induced and Modified by Drugs, by A. E. M. McLean, Elizabeth McLean, and J. D. Judah; 4. The Constitution and Genesis of Amyloid, by Alan S. Cohen; 5. Complement: Hemolytic Function and Chemical Properties, by P. G. Klein and H. J. Wellensiek. C. V. R.

The Structure of Atoms and Molecules. By V. Kondratyev. (Dover Publications, Inc., New York), 1965. Pp. 530. Price \$ 2.50.

This Dover English Translation of the original Russian text-book gives a general survey of modern physics in all its aspects including recent developments. It covers nearly all the

topics included in the syllabus on modern physics for undergraduate physics course. Thus there are chapters on Electrons and Quanta; Atomic Nucleus, Atomic Structure and Atomic Spectra; Quantum Mechanics; Molecular Structure and Nature of Chemical Forces; Molecular Spectra and Electrical and Magnetic Properties of Atoms and Molecules. It will be a suitable supplementary text-book on modern physics for students of physics and chemistry.

A. S. G.

Advances in Agronomy (Vol. 17). Edited by A. G. Norman. (Academic Press, Inc., New York), 1965. Pp. 386. Price \$14.00.

The leading article in the present volume is by L. B. Nelson on "Advances in Fertilizers" which gives a comprehensive review of the newer developments in fertilizer technology and usage. A second review article of value is the one on "Sweetclover Improvement" by W. K. Smith and H. J. Gorz. Sweetclover has been recognized from early times as a plant useful to man, but only in the present century has it assumed any importance as a crop plant. In this article the authors have brought out the varied nature of breeding researches that has transformed sweetclover from an aggressive inhabitant of waste places to a valued legume that has exceptional flexibility in use.

Another article which is intimately connected with everyone's daily bread is the one on "Breeding Wheat for Quality" by E. R. Hehn and M. A. Barmore. Modern mechanisation of the milling and baking processes of wheat and wheat products has placed exacting demands upon the wheat kernel. Cereal chemists and plant breeders have made impressive contributions towards the production of superior quality grains that will satisfy the demands of milling and baking. The authors give an account of the work that has been done in this direction.

In the article "Progress and Problems in Tree Fruit and Nut Production" the authors H. J. Brook, H. W. Fogle and J. W. McKay discuss the subject with special reference to the United States, and stress the necessity for research in various directions.

The remaining three articles relate to soils, and they are: "Classification and Properties of Organic Soils" by R. S. Farnham and H. R. Finney; "Colorado Mountain Soils" by D. D. Johnson and A. J. Cline; and "Structural Chemistry of Soil Humic Substances" by G. T. Felbeck, Jr.

A. S. G.

Indian Scientific and Technical Publications (1960-1965)—A Bibliography. (The Council of Scientific and Industrial Research, New Delhi), Pp. 248. Price Rs. 10 or 36 sh. or \$6.00.

Under the auspices of the Council of Scientific and Industrial Research, New Delhi, periodic exhibitions of Indian Scientific and Technical Publications are being organised. The first exhibition was held in 1960 and a bibliography of scientific and technical publications brought out up to 1959 in English and various regional languages of the country was compiled after the exhibition.

The present publication is the result of the second exhibition organized in 1965 and the bibliography lists about 4,500 books and over 750 periodicals brought out in the country during the years 1960-1965 most of which were displayed at the exhibition.

The Dewey Decimal Classification has been used in the arrangement of entries. There are also authors and subjects indices and a list of Indian publishers of scientific and technical literature.

A. S. G.

Sex Chromatin and Applied Cytogenetics. By J. D. S. Kumaran and S. J. Kumaran, Jr. (S. Bhattacharya and Co., 49, Dharamatala Street, Calcutta-3), 1965. Pp. 165. Price Rs. 10.

This informative monograph on "Sex Chromatin" includes the findings of latest researches on the subject and with its list of more than 500 references to original literature should prove of value to students and investigators in this developing field of work.

A. S. G.

Selected Topics in Modern Chemistry (Series Editor. H. H. Sisler and C. A. Vander Werf. (Chapman and Hall Ltd., 11, New Fetter Lane, London E.C. 4)—*Chemical Energy* by L. E. Strong and W. J. Stratton, Pp. 115. Price 10 sh. 6 d.; *Principles of Chemical Equilibrium* by K. B. Morris, Pp. 114. Price 10 sh. 6 d.; *Physical Methods for Determining Molecular Geometry* by W. S. Brey, Jr. Pp. 117. Price 10 sh. 6 d.

The previous monographs issued in this series of useful guide-books for students and teachers of chemistry were reviewed in these columns (*Curr. Sci.*, 1965, Vol. 34, Pp. 388, 545). Three more titles have come out in March 1966. The essential theme of the book *Chemical Energy* is to bring out the application of the concepts of energy and entropy to the interpretation of chemical change. *Principles of Chemical Equilibrium* is a lucid treatment

at an elementary level of the following essential topics in chemical equilibrium, namely, heterogeneous equilibrium and the phase rule, non-ionic chemical equilibrium; and, in the main, ionic equilibrium. In *Physical Methods for Determining Molecular Geometry* the author gives a broad outline of the principles involved in the various modern methods used by physical chemists to unravel the structure of molecules. The treatment is somewhat oversimplified but it will help in a general way to understand how the results on molecular structure are obtained by experiments. A. S. G.

Books Received

The M.S. University of Baroda Botanical Memoir (No. 1)—*The Flora of Pavagadh*. By A. R. Chavan, G. M. Oza. (The Department of Botany, Faculty of Science, M.S. University of Baroda, Baroda), 1966. Pp. vi + 296. Price Rs. 12.

Classical Mechanics. By T. W. B. Kibble. (McGraw-Hill Publishing Co., Shoppenhangers Road, Maidenhead, Berkshire), 1966. Pp. xv + 296. Price 42 sh.

Vibrations, Waves and Diffraction. By H. J. J. Braddick. (McGraw-Hill Publishing Co., Shoppenhangers Road, Maidenhead, Berkshire), 1966. Pp. x + 217. Price 36 sh.

Specific Replant Diseases. By B. M. Savory. (Commonwealth Agricultural Bureaux, Farnham House, Bucks, England), 1966. Pp. 64. Price 15 sh.

Advances in Ecological Research (Vol. 3). Edited by J. B. Cragg. (Academic Press, Inc., New York), 1966. Pp. xi + 324. Price 80 sh.

The Scientific Approach. By J. T. Davies. (Academic Press, Inc., New York), 1966. Pp. x + 100. Price 32 sh. 6d.

The Orchids of Bombay. By H. Santapau and Z. Kapadia. (The Manager of Publications, Civil Lines, Delhi), 1966. Pp. 239. Price Rs. 15.

Announcements

Institution of Chemists (India)—Associateship Examination, 1967

The Seventeenth Associateship Examination of the Institution of Chemists (India) will be held in November, 1967. The last date for Registration is 30th November 1966. Further enquiries may be made to the Honorary

Secretary, Institution of Chemists (India), Chemical Department, Medical College, Calcutta-12.

Symposium on 'Water Resources of India'

The Indian Geoscience Association is organising a symposium on the 'Water Resources of India' which will be held at Hyderabad during the first week of October 1966. The subject of the symposium has been divided into the following seven sections: (1) Organisation of Hydrological Studies in India; (2) Meteorology with Special Reference to Hydrology; (3) Surface-water Resources; (4) Ground-water Resources; (5) Geophysics in Ground-water Studies; (6) Geochemistry of Water; and (7) Hydrological Equipment and Instrumentation.

Intending participants should write for further information to the Secretary, Indian Geoscience Association, c/o Geological Survey of India, 10-3-410, Farhat Mansions, Hyderabad-28 (A.P.).

Symposium on 'Comparative Endocrinology'

The Fifth International Symposium on 'Comparative Endocrinology' will be held in New Delhi from 23rd to 28th November 1967. The topics to be discussed in the symposium are: 1. Endocrinology of the Agnatha and Protochordata, 2. Endocrine Control of Molting and Pigmentation, 3. Endocrine Control of Central Nervous Function, 4. Comparative Endocrinology of Reproduction, 5. Adaptive Mechanisms, 6. Thyroid, 7. Comparative Physiology of Prolactin, 8. Comparative Endocrinology of the Invertebrata.

The main papers will be given by invited speakers. All interested in Comparative Endocrinology are invited to attend. Further information may be obtained from Dr. M. R. N. Prasad, Department of Zoology, University of Delhi, Delhi-7.

Seminar on 'Electrometric Methods in Analytical Chemistry'

The Chemistry Department of Sri Venkateswara University proposes to hold a Seminar on 'Electrometric Methods in Analytical Chemistry' with U.G.C. assistance for about three days in the third week of November 1966. Intending contributors are requested to contact Dr. V. R. Krishnan, Reader in Chemistry, Sri Venkateswara University, Tirupati (A.P.), for further details. Titles and abstracts of papers to be presented at the seminar are to be sent before 30th September 1966.

FISHERY RESOURCES OF THE INDIAN OCEAN*

N. K. PANIKKAR

National Institute of Oceanography, CSIR, New Delhi

I. INTRODUCTION

INTEREST in Indian Ocean Fisheries has been a comparatively recent development in the history of world fisheries and has principally stemmed from efforts of countries like India to step up their supply of protein to their large populations. These efforts of the Asian countries have been assisted by United Nations Agencies, notably the Food and Agriculture Organization. A third contributory factor has been the efforts of countries with distant water fishing fleets to operate in the Indian Ocean. Pioneer work of this type has been the fishing effort of Japan in the Indian Ocean, particularly for tuna, and the more recent efforts of the Soviet Union at exploratory fishing. Australia, South Africa and India have been engaged in exploratory surveys in the regions of the Indian Ocean near their own coasts.

When the programmes of the International Indian Ocean Expedition were formulated, fisheries potential was used as an impressive argument to stimulate interest in the project in the Asian and African countries. A quarter of the world's population lives in countries bordering the Indian Ocean, largely in low nutritional standards in terms of calories and acute deficiency in terms of animal protein. Pressure on land use was acute in most countries and added food resources from the sea were clearly indicated as a much needed economic and nutritional corrective. Basic fisheries programmes and attendant biological surveys were included in the earlier draft proposals; physical oceanography was closely dovetailed to chemical biology and plankton studies. In spite of all these, the actual fisheries work accomplished during the expedition itself has been disappointingly small, a fact which is not unconnected with the lack of facilities for exploratory fishing in most ships which took part in the Expedition, with heavily weighted programmes in physical, chemical and geological work. The results of these studies need not be considered negative by those interested in fishery science because the expedition results are clearly bringing out many features of physical and chemical oceanography

of the Indian Ocean which have close bearing on the location of fisheries resources, particularly the mapping of areas of upwelling and the movements of the low oxygen waters.

II. PREVIOUS REVIEWS

In a brief account as this, it will not be possible to evaluate critically all the available data but the broad features are given as have emerged from the various studies which are going on in different centres of marine research. Further exploratory and commercial fishing requires more critical evaluation of physical and chemical data collected on a synoptic basis to make fishing operations in specified regions economical. Following the International Indian Ocean Expedition, it is hoped that such critical work will be taken up by the Indian Ocean countries themselves within the forthcoming years.

III. PHYSICAL AND CHEMICAL FEATURES OF THE INDIAN OCEAN

Seasonal mixing of surface and deep waters as occurs in the colder latitudes does not occur in most parts of the Indian Ocean and one has to look for the areas of divergence and upwelling to find the turnover of bottom waters to the surface. Two areas of the Indian Ocean, the Red Sea and the Persian Gulf are regions of high salinity and temperature and of these, the higher salinity influences the Northern Arabian Sea. Apart from this, the intense evaporation in the northern part of the Arabian Sea is also responsible for the high salinity of the waters of this region. The Bay of Bengal on the other hand represents waters warmer than the Arabian Sea but with pronounced estuarine influence with several large rivers opening into it. The average salinities are lower here than in the Arabian Sea.

The southern half of the Indian Ocean has characteristics not unlike the southern basins of Pacific and Atlantic bordering on the Antarctic. From the fishery point of view it is noteworthy that for most parts of the entire Indian Ocean, the continental shelf is narrow.

One of the features of the Indian Ocean is the fact that it is largely influenced by the monsoons. The formation of the monsoons and related atmospheric phenomena have been discussed by other speakers at this Congress. The

* Summary of lecture delivered at the Second International Oceanographic Congress, Moscow, 7th June 1966.

monsoon systems are specially pronounced in the Arabian Sea and the Bay of Bengal both the areas being entirely under the regimes of the south-west and north-east monsoons. The southern hemisphere is free from these large-scale wind systems except to a small extent towards west of Australia and to the east of South Africa.

The strong south-west winds during May to early September often deflect large masses of water from the surface and the replenishment of these by the deeper waters result in upwelling. One important area where upwelling following strong offshore winds occurs is the Somali coast, where, in addition, a powerful current going northwards of East Africa in a clockwise direction grazes Arabia, Pakistan and even up to Indian West Coast. This summer pattern is reversed in the north-east monsoon time when offshore winds off the Kathiawar Peninsula result in upwelling particularly in the Gulf of Cambay (Jayaraman and Gogate, 1957).⁷ Similarly large-scale upwelling occurs during the south-west monsoons in the south-west coast of India, there is the complex phenomenon of several physical factors acting together the net result of which is the large-scale movement of high nutrient laden, low temperature and low oxygen waters to the surface (Panikkar and Jayaraman, 1956).²

One physical feature of the Indian Ocean which has been noted in former years but has come to special comment and observations during the International Indian Ocean Expedition is the regime relating to waters and bottom areas having little or no oxygen. Certain areas in the Arabian Sea have been known as azoic areas from the time of the John Murray Expedition (Sewell, 1955)⁵ and several such areas have been noted by Soviet Ships where the azoic conditions prevail in several parts of the western shelf in Gulf of Cambay and off Arabia.

It has been observed by most of the ships participating in the Indian Ocean Expedition that the waters of the Arabian Sea are deficient in oxygen reaching the minimum by about 200-500 meters. It has further been observed by Indian workers and by other ships that the actual oxygen minimum layer comes fairly close to the surface towards the west coast of India during the south-west monsoon regime (Panikkar and Jayaraman, 1966). More critical work is needed to correlate wind force and upwelling. The movements of the oxygen minimum layer may have the beneficial effect of concentrating populations of fish towards the

coast in certain seasons but it is equally possible that in the open ocean the surface areas of high productivity do not reach their culmination into profitable fisheries owing to the calamitous effects of low oxygen water. These may well be the cause of large-scale fluctuations in certain fisheries as of the oil sardine of the Indian West Coast and of large-scale mortalities.

IV. BIOLOGICAL ASPECTS OF THE INDIAN OCEAN

The major part of the Indian Ocean from the fisheries point of view is composed of a tropical Northern two-thirds of the ocean which is continuous in faunal characters with the larger marine Indo-Pacific area which is a distinct marine zoogeographical division. This area covers the Arabian Sea, Bay of Bengal, Eastern Central Indian Ocean and the smaller seas associated with the eastern archipelago and the equatorial region. The other regions which have specific biological characteristics are the temperate South African region which has characteristic temperate fisheries, the West Australian region which has comparable but different fisheries and an East African tropical region which has tropical fisheries, different from the Indo-Pacific. The Gulf of Aden has certain specific fishery characters but in the main, the commercial species are dominant elements of the Indo-Pacific fauna. Finally, there is the oceanic fishery consisting mainly of stocks of tuna, sail-fish, etc., which assume considerable importance in the Eastern Central Indian Ocean.

The tropical Indian Ocean waters are likewise regions where extensive coral reefs are found with several hundreds of coral islands. While the reefs have contributed much to the remarkable diversity of animal and plant life in the Indian Ocean harbouring several thousands of species forming a reef fauna and flora, it has not contributed to large-scale fishing banks. Even good stocks on reefs are difficult to exploit owing to hazardous fishing on reefs.

The principal features relating to fisheries on the Indian Ocean are that the pelagic and mid-pelagic species dominate the commercial catches with a corresponding reduction in numbers of the ground fish suitable for large-scale trawling. The gadoids which form extensive fisheries in North Atlantic and North Pacific are conspicuous by their absence; this group is represented only by one genus (*Bregmaceros*) whose yield is negligible. Similarly the flat fishes also occupy a low place in the total production and many of them are of small size and confined to the inshore areas.

The southern part of the Indian Ocean to the east of Southern Africa and to the west of Australia, however, present characteristics which are common with the temperate zones with an increased predominance of ground species including the larger gadoids and lobsters.

Most commercial species are characterised by having comparatively longer breeding seasons and one of the peculiarities of fish stocks is the predominance of the younger age groups in the commercial catches. According to a rough calculation, nearly 3/4ths of the entire catches in the Indian Ocean are taken up by fish not more than three years old and even among this, the zero year class is a major contribution to the fisheries in the warmer regions where the rate of growth is rapid. It is in this context that the close relationship between areas of upwelling, high productivity and dense plankton assume special significance in the location of commercial fisheries.

A feature of the Indian Ocean fish fauna in relation to the coastal fisheries whose importance is not often appreciated is that throughout the Indo-Pacific there are important species which are primarily found in the sea and breed in the sea and coastal waters, but ascend estuaries and coastal lagoons when they are young. Annual migrations of young fish of this type take place throughout the coastline and the yield from their harvest in the areas immediately adjoining the coastline is very considerable. To this category belongs the well-known Milk-fish, *Chanos chanos*, species of mullet and of penaeid prawns. Species like *Hilsa* which are migratory estuarine fish are important on the coasts of Pakistan and India.

In the Indian Ocean are the areas like Persian Gulf which are shallow platforms forming continental shelves like the North Sea but unfortunately the productivity of these areas is very low. The indications are, therefore, that speaking for the whole area the prospects for trawl fishing are limited except in certain regions where specialised conditions seem to favour such efforts. Areas to the west of Port Okha and west of Ceylon, some regions of the Gulf of Oman and the western coast of Australia and eastern and southern coasts of South Africa are probably areas where efforts in trawling would be commercially successful.

V. FISHERIES YIELDS FROM THE INDIAN OCEAN

Production of fish in the Indian Ocean during the past 15 years or so has, according to FAO fisheries statistics, increased from 1.3 million

tons to about 1.8 million tons in 1964 although a still higher figure of 1.9 million tons was touched in 1960. These figures are not likely to be complete. Rass (1965)⁴ has estimated the yield at about 2.0 million tons but my own estimate of current production is of the order of 2.5 million tons, but in the following discussions FAO figures have been taken as the basis. The trend of the landings also shows that the increase has taken place both in western and eastern Indian Ocean; but since the output from the western Indian Ocean is greater than the eastern, the present total production is roughly of the order of 1 to 1.1 million tons in the western Indian Ocean, as against 0.8 million tons on the eastern Indian Ocean. In relation to total world marine catch, however, the increase in the Indian Ocean is far from impressive and in fact the percentage contributed by Indian Ocean to the world catch has decreased from about 7% in 1949 to 5% during the past few years. The production from the western and eastern areas in relation to the world total catch is of the order of 3% for the western Indian Ocean and 2% for the eastern Indian Ocean. Considering 1957-59 as the base year at the Index Number 100, the marine fisheries of the Indian Ocean in 1964 has registered an increase to 112, as against the world marine catch increase to the Index Number of 157. These figures show that increase in yield from Indian Ocean has not kept pace with the increase in world catch and indicates the scope of further output. Even assuming that the rate of increase as has taken place in other parts of the world is all that is possible, we should expect the 2.5 million tons to improve to 3.6 million tons with better technology and effort. The rate of increase at least for quite some years could be substantial with more effort because many fisheries have hardly been touched at all, many offshore stocks are not exploited and many inshore stocks are underfished.

At present the major fish-producing country of the region is India with an yield of about 900,000 tons.

The production from the East African countries is at present of the order of 65,000 tons which is shared by 12 countries. The largest yield is from Tanzania, the total production from Zanzibar and Tanganyika accounts for nearly 20,000 tons. Next in importance is the Malagasay Republic 15,000 tons (average for 1961-63) and Ethiopia, mostly on the Red Sea side at 11,000 tons. It is interesting to note

that nearly 45% of the contribution from East African countries are demersal fisheries with the sardines ranking next (18.5%). A very promising area of the African coast is the Mozambique coast as judged by productivity, where the present yield is only 4,000 tons. The Somali region, Gulf of Aden and the areas of Gulf of Oman are promising areas for further effort. This is borne out by nutrient distribution and primary production studies. One of the clear tasks will be to differentiate between pelagic, mid-pelagic and demersal stocks and to assess their intensity, and to establish the niche at which the high productivity results in good commercial fisheries.

VI. FUTURE PROSPECTS OF INDIAN OCEAN FISHERIES

What then are the prospects for expanding the existing fisheries? It may be argued with reasonable certainty that productive regions like the Andaman Sea, West coast of Burma, Coasts of Ceylon, West Coast of India, Coast of West Pakistan, Gulf of Aden and Oman, Somali Coast, South African and West Australian coasts are all areas where substantial increase in production is possible from stocks already known and partially exploited. Gulf of Aden, Somali region and South-West Coast of India deserve special mention if phosphates, chlorophyll and phytoplankton are taken into consideration. Some authors have calculated a scope of increase nearly as much as 10 times the present landings and this increase in the yield of the neritic pelagic complex of fishes appears feasible, whereas a much larger increase based on new stocks is quite possible in the newly found productive areas like the Gulf of Aden, Gulf of Oman and Somali coasts.

As regards increased capacity for trawler yields the scope really lies in fishing beyond the marginal seas on the shelf and on the slope of the shelf. Here, experience obtained on the west coast of India in the Kathiawar area might well be indicative of what might be found in the other Arabian Sea areas where the shelf is productive. From trawler fishing the increase may not be much in terms of total yield but substantial in terms of value.

Another bright future is with reference to oceanic fisheries—tunas and other larger Scombroids. Here we may expect a substantial increase from the present 150 thousand tons per annum. The Gulf of Aden is a most promising area for long lining and purse seining for tuna showing some of the highest catch

rates recorded and the average Indian Ocean yield of tuna obtained by Japanese vessels are higher than in the Pacific and Atlantic.

The increase in Crustacean fisheries would take place by bringing many areas to fishing but with increased attempts to find out the deep water prawns in the farther waters of the shelf and even on the slope. Prawns which are capable of utilising the coastal inlets for quick growth and development already feature largely in the crustacean production of some Indian Ocean countries and it is to be expected that these practices will become widely spread, based on the breeding oceanic stocks and the young zero year class growing rapidly in coastal belts.

A fishery which is now of low magnitude but which offers great scope in the future relates to the Mollusca which are capable of giving very high yields from the shallow coastal areas of the tropical seas. The yield per acre is exceptionally high and may figure very considerably in future years.

The general picture emerging out of the present information on the fisheries resources of the Indian Ocean and the oceanographic data which are accumulating as a result of the International Indian Ocean Expedition is that there is much scope for increased production from the Indian Ocean than the present rough yield of about 2.5 million tons. Increase in pelagic fisheries is possible in areas which have been diagnosed as areas of divergence and upwelling, higher dissolved nutrients, and higher plankton biomass.

Apart from the well-known pelagic fisheries and the shoaling species of sardines and the scombroids the indications are that the actual fish stocks with reference to an individual species are not of a large magnitude. Instead, there exist a large number of smaller fisheries composed of species with wide range of distribution but forming commercial fisheries in areas widely distant from one another. In many areas of the Indian Ocean the large increase is to come from exploitation of the waters adjoining the coast directed to utilize these miscellaneous fisheries. The technological needs for substantial increase from these fisheries are:—

1. Modern techniques of fish finding and scouting of large concentrations of scombroids and clupeoids in the highly productive areas.
2. Methods to concentrate the somewhat sparse populations of miscellaneous groups of fishes by entirely new techniques

involving the use of light, sound or electricity to make the yield economical.

3. Intensive studies on selected parameters like temperature and oxygen distribution to locate the fish stocks and their area-wise distribution in different seasons.

It was mentioned in an earlier section that the present yield from the Indian Ocean may roughly be put as 2.0 million tons, and taking into account subsistence and unaccounted sources, as about 2.5 million tons. Fisheries expansion is not entirely determined by the availability of resources but influenced by the needs, capabilities and technological improvements taking place in any country. Experience has shown that this change is not rapid. There are the extremes of very slow development at one end where changes are imperceptible and at the other of rapid introduction of modern fishing craft and gear and all attendant facilities. Both these have acted in the Indian experience of marine fish production, where the general trend is that the output is roughly doubled during a 10-year period. It may not be far off the mark if this rate of development is taken as average

for most other Asian and African countries, where there is the need for such expansion, economic support and technical feasibility. In this case the output from the Indian Ocean could roughly be indicated as about 20 million tons per annum towards the close of this century. This is apart from large-scale individual fisheries for oceanic stock like tuna, sardines or mackerel mainly in the upwelling areas where newer and imported technology and factory ships might make substantial catches possible. The outlook for the future of Indian Ocean Fisheries is, therefore, one of moderate optimism. The hope that Indian Ocean can provide a substantial contribution to the food supplies of the bordering countries is fully backed by the newer knowledge of oceanography.

1. Jayaraman, R. and Gogate, S. S., *Proc. Ind. Acad. Sci.*, 1957, **45 B**, 151.
2. Panikkar, N. K. and Jayaraman, R., *Proc. 8th Pacific Science Congress, Philippines (1953)*, 1956, p. 1111.
3. — and —, *Proc. Ind. Acad. Sci.*, B, 1966 (In press).
4. Rass, T. S., *Trudy Institut. Okeanologii*, 1965, **80**, 1.
5. Sewell, R. B. S., *Proc. Linn. Soc. London, Session 165*, 1955, p. 188.

A RAPID METHOD OF SPECIFIC IDENTIFICATION OF JAPANESE ENCEPHALITIS—WEST NILE SUBGROUP OF ARBOVIRUSES

KHORSHED M. PAVRI AND B. H. SHEIKH

Virus Research Centre, Poona*

CASALS (personal communication, 1957) described a simple complement fixation (CF) test with crude antigens and mouse hyperimmune sera, as a useful tool for placing a new isolate of arbovirus in a group (Casals' group A, B, C, etc.). Because of its great simplicity, the method, often referred to as 'quick CF', with a few modifications, has been extensively used at the Virus Research Centre (VRC), Poona, for rapid identification of new isolates as well as in experimental transmission studies. Briefly, a 10% suspension of the infected, infant or adult mouse brain is prepared in saline (0.9%) and centrifuged at 5,000 rpm for

60 minutes. The undiluted supernatant is immediately tested as a CF antigen with two-fold serial dilutions of hyperimmune sera prepared in mice. Although the mouse brains are frequently stored for long periods of time at -50°C . the suspensions are always prepared at the time of use.

By this method, it has been easy to distinguish Kyasanur Forest disease and dengue viruses from one another as well as from Japanese encephalitis (JE) and West Nile (WN) viruses, all group B arboviruses, known to be present in India. However, it has not been possible to distinguish between the viruses of the JE-WN subgroup by this technique. Since these two viruses are known to occur simultaneously in North Arcot District, Madras State (VRC unpublished data) and might also be occurring together in other parts of India, it was thought worthwhile to develop a relatively

* The Virus Research Centre is jointly maintained by the Indian Council of Medical Research and the Rockefeller Foundation. The Centre also receives a grant (3×4307) of the PL 480 Funds from the National Institutes of Health, U.S.A., through the Indian Council of Medical Research.

TABLE I

Results of Checkerboard CF test employing extracted antigens and absorbed and unabsorbed hyperimmune sera

A+E Antigens	Hyperimmune sera							
	JE sera				WN sera			
	Nakayama		P 20458		E 101		643009	
	Absorbed	Unabsorbed	Absorbed	Unabsorbed	Absorbed	Unabsorbed	Absorbed	Unabsorbed
JE								
Nakayama	64/>128†	>128/>128	>128/>128	>128/>128	<8/<8	64/>128	<8/<8	16/>128
P 20458	64/64	>128/64	64/64	>128/>128	<8/<8	64/32	<8/<8	16/32
WN								
E 101	<8/<16	32/32	<8/<16	32/32	>128/128	>128/128	32/64	64/128
643009	<8/<8	16/8	<8/<8	16/16	64/16	>128/32	16/16	32/32

† Numerator = The highest titre of the serum ; Denominator = The highest titre of the antigen.

simple and quick method of specific identification in place of the usual, more elaborate serological techniques.

Clarke¹ studying the antigenic analysis of the JE-St. Louis-WN subgroup of arboviruses, by antibody absorption followed by haemagglutination inhibition (HI) tests, reported that each virus contained a completely specific antigen as well as one or more cross-reactive components. By following the same antibody absorption technique, we were able to remove the heterologous HI and CF antibodies employing 3-5 grams of mouse brains infected with the heterologous virus, per 1 ml. of the undiluted serum. Thus, hyperimmune mouse sera prepared against the Nakayama strain and an Indian strain of JE virus, *viz.*, VRC No. P 20458, were absorbed with E 101 strain of WN virus, and the hyperimmune sera for E 101 and an Indian strain of WN, *i.e.*, VRC No. 643009, were absorbed with the Nakayama strain of JE virus.

An aliquot was removed, treated with kaolin and tested in HI as described¹ with specific results. The remaining absorbed sera, after inactivation at 60° C. for 20 minutes, were tested in CF.² The results of Checkerboard CF test with acetone ether extracted antigens and the absorbed and unabsorbed sera, presented in Table I, indicate CF results to be very similar to those obtained in HI test. The absorbed sera yielded completely specific reactions with a slight loss in CF antibodies for the homologous antigen. CF tests employing 'crude' undiluted antigens, prepared from a

single infected infant mouse brain, of various strains of JE and WN viruses isolated and identified in India, are shown in Table II. The

TABLE II

CF tests with crude antigens and absorbed and unabsorbed hyperimmune sera

Crude antigens	Hyperimmune sera			
	JE Nakayama		West Nile E 101	
	Absorbed	Unabsorbed	Absorbed	Unabsorbed
JE (Nakayama) ..	64†	>128	<8	64
WN (E 101) ..	<8	64	>128	>128
WN (G 2266) ..	<8	>128	>128	>128
JE (P 20778) ..	>128	>128	<8	>128
JE (P 20458) ..	>128	>128	<8	>128
WN (643009) ..	<8	64	>128	>128
WN (643658-2) ..	<8	64	>128	>128
JE (G 3012) ..	>128	>128	<8	64

† CF titre of the serum with undiluted crude antigen.

absorbed serum in every instance, showed completely specific results making identification of the isolates as certain as with the previously applied more elaborate procedure.

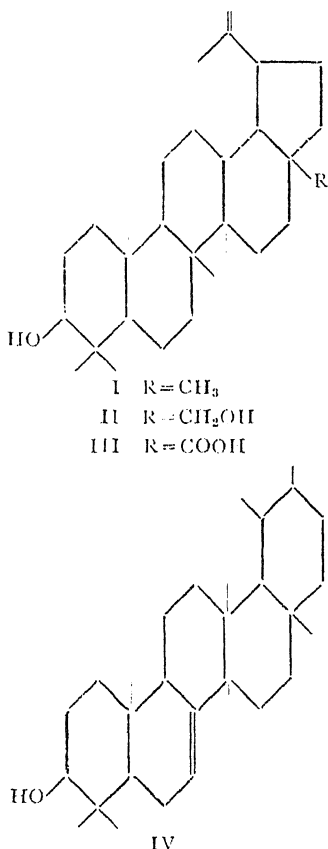
1. Clarke, D. H., *J. Exp. Med.*, 1960, **111**, 21.
2. Pavri, K. M., Gokhale, T. and Shah, K. V., *Ind. J. Med. Res.*, 1962, **50**, 153.

THE CHEMICAL EXAMINATION OF DIOSPYROS SPECIES

L. RAMACHANDRA RAO, C. SANKARA RAO AND T. SUNDARA RAMAIAH
Andhra University, Waltair

Part III. The Triterpenes of the Leaves of *D. melanoxylon*

P. S. RAO *et al.*¹ examined the leaves of *D. melanoxylon* and reported the presence of a new triterpene alcohol, m.p. 212–13° ($C_{30}H_{50}O$) from the petroleum ether extract besides lupeol (I) and betulin (II) and another new monohydroxy monocarboxylic acid, m.p. 272–74°, from the acetone extract. The new acid was also named by them Diospyric acid.



The mixture of lupeol (I), betulin (II) and the new triterpene alcohol could be effectively separated by chromatography following the method of P. S. Rao *et al.* But separation of the new triterpene alcohol was found simpler if the total mixture was acetylated and the mixture of acetates extracted with hot ether by decantation. The insoluble fraction, after two crystalli-

sations from chloroform-methanol, gave pure acetate of the new triterpene alcohol as colourless shining plates, m.p. 282–84°, (α)_D^{30°} – 2.5°. Deacetylation with 8% methanolic alkali followed by crystallisation from methanol furnished the alcohol as colourless soft needles [m.p. 208–10°, (α)_D^{30°} – 18°, I.R.: OH–3630 cm^{-1} , $>C=C<H$ –824 cm^{-1} , N.M.R.: τ 4.62 (m) olefinic proton, U.V. $\lambda_{max}^{ethanol}$ 205 $m\mu$ only]. Among other reactions such as the formation of a ketone and a hydrocarbon through Wolff-Kishner reduction of the ketone, two reactions have pointed out the likelihood of the new compound being identical with bauerenol (IV).² The new triterpene suffers isomerisation with dry HCl in chloroform [colourless plates from methanol, m.p. 166–68°, (α)_D^{30°} + 39°, I.R.: OH–3620] and also when shaken with Pt/H₂ in chloroform. The isomeric product does not show any peak at τ 4.62 in N.M.R. suggesting the shift of the double bond to a tetrasubstituted position. Similar isomerisation was observed with $\Delta^{7(8)}$ triterpenes such as mastiacadienonic acid,³ butyrospermol⁴ and multiflorenol.⁵ The identity of the new triterpene with bauerenol (IV) was further confirmed by the SeO₂ oxidation of its acetate when a hetero-annular diene was produced [colourless plates from chloroform-methanol, m.p. 266–68°, (α)_D^{30°} – 110°, λ_{max} 231, 237, 246 $m\mu$ cf. $\Delta^{7(8)}$,⁹ (11) baueradienol acetate λ_{max} 232, 239, 247 $m\mu$].

Finally this identification was confirmed (m.m.p.; I.R.) by direct comparison of its acetate with a sample of bauerenol acetate kindly provided by Prof. F. N. Lahey to whom our thanks are due.

Our next attention was directed to the new monohydroxy monocarboxylic acid, diospyric acid of P. S. Rao *et al.* After extraction with petroleum ether, the leaves were extracted with hot alcohol. The ether-soluble fraction of the alcoholic extract was shaken with 5% NaOH and the triterpene acid precipitated with dilute hydrochloric acid. The ether and alcoholic residual extract contained no more triterpenes.

The triterpene acid fraction was found to be a mixture (m.p. 260–70°) and hence esterified with diazomethane and passed over chromatographic alumina. Petroleum ether and petroleum ether-benzene (1 : 1) eluates afforded a colour-

less compound (m.p. 110–20°) which showed at least two spots on T.L.C. Further elution of the column with benzene furnished methyl betulinate (III), m.p. and m.m.p. with authentic methyl betulinate 220–22°, (α)_D^{30°} + 5°.

The mixture from petroleum ether and petroleum ether-benzene eluates was acetylated and the resulting methyl ester acetate crystallised from methanol. The first fraction, m.p. 244–46°, (α)_D^{30°} + 60° was the largest and showed uniformity on T.L.C. On hydrolysis with 8% alcoholic KOH a monomethyl ester was obtained, m.p. and m.m.p. with authentic methyl ursolate 168–70°, (α)_D^{30°} + 55°. Hydrolysis of the methyl ester with 10% KOH in ethylene glycol afforded ursolic acid, m.p. and m.m.p. with authentic ursolic acid 276–78°, (α)_D^{30°} + 65°.

Upon concentration of the mother liquors, the second minor fraction separates out, as colourless needles, m.p. 218–20°, (α)_D^{30°} + 60°. Deacetylation with 8% alcohol KOH afforded methyl oleanolate, m.p. and m.m.p. with authentic methyl oleanolate 198–200°, (α)_D^{30°} + 75° which on hydrolysis with 10% KOH-ethylene glycol furnished colourless plates from methanol, m.p. and m.m.p. with authentic oleanolic acid, 306–308°, (α)_D^{30°} + 75°.

The physical data given by P. S. Rao *et al.* for Diospyric acid [m.p. 272–74°, (α)_D^{30°} + 66°; methyl ester acetate, m.p. 244–46°, (α)_D^{30°} + 48.5°, methyl ester 117°] closely agree with those of ursolic acid and its methyl ester acetate, although the methyl ester itself was given a low m.p. It is clear that the mixture of methyl esters cannot be separated by fractional crystallisation; but their acetates do separate out readily in this way.

Thus, the leaves of *D. melanoxylon* contain not only lupeol (I) and its two oxidation variants, betulin (II) and betulinic acid (III)^{6,7} but also ursolic and oleanolic acids besides bauerenol (IV) which is closely related to α -amyrin. Such co-occurrence has great biogenetic significance.

Part IV. The Triterpenes of *D. sylvatica* and *D. melanoxylon*

The co-occurrence of lupeol (I) and its 28-CH₂ oxidation variants, betulin (II) and betulinic acid (III) has been already recorded in *Diospyros* species^{6,7} (Part II). Similar in-

stances have been now noticed in the bark of *D. sylvatica* and in the fruits of *D. melanoxylon*.

From the bark of *D. sylvatica*, petroleum ether extract furnished a mixture of lupeol (I) and betulin (II) while the ether extract exclusively deposited betulinic acid (III) in an yield of 0.75%, m.p. 299–301°, (α)_D^{30°} + 3°; acetate 285–87°, (α)_D^{30°} + 25°; methyl ester 219–21° (α)_D^{30°} + 5°. The separation of lupeol (I) from betulin (II) was successfully achieved by chromatography on alumina. With 500 mg. of the mixture (alumina column 40 × 2.5 cm.), petroleum ether eluate did not yield any component. But petroleum ether-benzene (100 ml.) gave colourless needles [MeOH, 230 mg., m.p. 210–12°, (α)_D^{30°} + 25°; acetate m.p. 210–12°, (α)_D^{30°} + 50°]. This compound and its acetate agreed in all respects (m.m.p.; I.R.) with lupeol (I) and its acetate. Elution with benzene (100 ml.) afforded a compound (240 mg.) as colourless needles from methanol [m.p. 250–52°, (α)_D^{30°} + 20°]; diacetate [m.p. 216–18°, (α)_D^{30°} + 25°], identical with betulin and its diacetate respectively.

By a similar method of extraction and chromatographic separation the petroleum ether extract of the sun-dried fruits of *D. melanoxylon* was shown to contain lupeol (I) and betulin (II). The ether extract did not contain any crystalline compound. Examination of the alcohol extract showed the presence of betulinic acid.

All compounds reported above analysed satisfactorily and the optical rotations were recorded in chloroform solution.

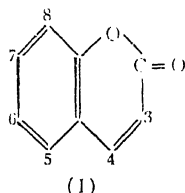
Our thanks are due to Prof. A. J. Birch for N.M.R. Spectra and one of us (C. S. R.) is grateful to the University Grants Commission for a Fellowship.

1. Gupta, R. K. and Rao, P. S., *Proc. Ind. Acad. Sci.*, 1964, **60 A**, 36.
2. Iahey, F. N. and Leeding, M. V., *Proc. Chem. Soc.*, 1958, p. 342.
3. Barton, D. H. R. and Seoane, E., *J. Chem. Soc.*, 1956, p. 4154.
4. Dawson, M. C., Halsall, T. G., Jones, E. R. II., Meakins, G. D. and Phillips, P. C., *Chem. and Ind.*, 1955, p. 918.
5. Lawrie, W., Hamilton, W., Spring, F. S. and Watson, H. S., *J. Chem. Soc.*, 1956, p. 3272.
6. Sengupta, P. and Khastgir, H. N., *Tetrahedron*, 1963, **19**, 123.
7. Ramachandra Row, L., Sankara Rao, C. and Sundara Ramaiah, T., *Curr. Sci.*, 1964, **33**, 367.
8. Kapil, R. S. and Dhar, M. M., *J. Sci. and Ind. Res.*, 1961, **20 B**, 498.

LETTERS TO THE EDITOR

PROTON MAGNETIC RESONANCE IN THE PYRONE RING OF COUMARINS

THE Chemical shifts of various protons give information regarding their relative shieldings and hence, in a rough way, relative electron densities at the proton sites. For a reaction with an electrophilic reagent, the more reactive is a position, the more is the electron density at that position. On this basis, Dharmatti *et al.*¹ in an earlier publication correlated the chemical shifts of the benzene ring protons in several coumarins with the reactivities at the corresponding positions. However, they did not discuss the effect of a substituent in the benzene ring on the chemical shifts of protons in positions 3 and 4 in coumarins (I).



Such a study is of interest because in fused ring systems no data are available so far, on the effect of a substituent in one ring on the chemical shifts of protons in the other. The present communication analyses the data already obtained in the earlier publication^{1,2} to get this information.

Table I gives the values of the chemical shifts for protons at positions 3 and 4 for ready reference.

TABLE I
Chemical shifts (in ppm relative to TMS) of protons at positions 3 and 4 in various coumarins

Position	Coumarin	6-nitro coumarin	Na-salt of coumarin 6-sulphonic acid	6-amino coumarin	5-hydroxy 4-methyl coumarin	6-hydroxy 4-methyl coumarin	7-hydroxy 4-methyl coumarin	7-hydroxy coumarin	8-hydroxy coumarin
3	-6.47	-6.61	-6.49	-6.26	-5.98	-6.11	-6.02	-6.06	-6.25
4	-7.93	-8.05	-7.93	-7.68	..	..	..	-7.67	-7.81

The data indicate that the presence of an electron withdrawing substituent such as NO₂ group in position 6 of the coumarin ring causes deshielding of protons at positions 3 and 4 while that of an electron donating group such as NH₂ group causes shielding of these protons. Moreover, the positions 3 and 4 are affected almost equally by the presence of the substituent

at position 6 as the difference in the chemical shifts between these protons is the same (1.44 ppm) irrespective of the nature of the substituent at this position. But the value is liable to vary depending on the position of substitution, *e.g.*, 7 and 8-hydroxy compounds.

The reactivity at position 3 when a hydroxyl group is substituted in the benzene ring can also be investigated from the chemical shift data for the various hydroxy coumarins. In some of the compounds studied, CH₃ group is an additional substituent at position 4. Comparison of the values of δ_3 in 7-hydroxy and 7-hydroxy 4-methyl coumarins shows at once that introduction of CH₃ group in position 4 increases the shift of proton in position 3 by 0.04 ppm. Assuming that in 5-hydroxy 4-methyl and 6-hydroxy 4-methyl coumarins, the CH₃ group has the same effect as in the 7-hydroxy 4-methyl coumarin, one obtains δ_3 for 5, 6, 7, and 8-hydroxy coumarins as -6.02, -6.15, -6.06 and -6.25 ppm respectively. Therefore, it can be concluded that the reactivity at position 3 is less when the hydroxyl group is at the most reactive positions³ namely 6 and 8, in coumarin than when the substituent is at other positions. The 6 and 8 positions are meta with reference to the side chain and can exert only inductive effect. The 5 and 7 positions (o and p) can in addition exert electromeric effect also and, therefore, the activating influence of the hydroxyl groups in these two positions is markedly higher. It is interesting to mention that exactly similar conclusion has

been drawn by Mathur⁴ from magnetic susceptibilities of isomeric hydroxy coumarins.

The results also indicate that there is extended conjugation between the benzene and pyrone rings and that the shielding at position 3 increases with an increase in the electron donating power of the substituent at position 6. Similarly, the deshielding at this position

also increases with the increase in the electron withdrawing power of the substituent at position 6. Therefore, one expects that the reactivity towards electrophilic substitution at position 3 should be higher for 6-hydroxy coumarin as compared to that for the 6-amino compound; it should also be more for coumarin 6 sodium sulphonate than for 6 nitro coumarin.

We are thankful to Prof. T. R. Seshadri, F.R.S., for helpful suggestions.

Tata Institute of C. R. KANEKAR.
Fundamental Research, C. L. KHETRAPAL.
Bombay, July 5, 1966.

1. Dharmatti, S. S., Govil, G., Kanekar, C. R., Khetrapal, C. L. and Virmani, Y. P., *Proc. Ind. Acad. Sci.*, 1962, **56**, 71.
2. Khetrapal, C. L., *Ph.D. Thesis*, Bombay University, 1965.
3. Thakur and Shah. *J. Univ. Bombay*, 1947, **16 A**, 38.
4. Mathur, R. M., *Ph.D. Thesis*, Bombay University, 1956.

CHEMICAL EXAMINATION OF CROTALARIA MEDICAGINEA

DURING our survey of several *Crotalaria* species we have examined *Crotalaria medicaginea*, which grows wild near Delhi. The whole plant has been used as fodder for camels.¹ The recent study of the nutritional value of this plant has revealed that the leafy part of the plant contains 30% protein. Since it is highly palatable, it has been introduced as a new fodder.² The decoction of the seeds of this plant is used in Ayurvedic since early times as tonic and corrective of blood.³

A survey of literature shows that the seeds of this plant has earlier been examined and reported to contain two alkaloids besides sterols and fatty acids but the nature of these bases has not been recorded.³⁻⁴ In view of the toxic nature of several *Crotalaria* species,⁵ a detailed chemical examination of this plant was considered necessary.

A sample of the plant including roots collected during the flowering season of Summer 1966 was air-dried, cut into bits and extracted with hot ethanol in a Soxhlet extractor. The extract was concentrated to a small volume and made acidic by the addition of an equal volume of aqueous 10% citric acid. The remaining alcohol was removed by distillation under reduced pressure. The acidic aqueous solution was extracted successively with petroleum ether, ether and chloroform to remove chlorophyll, sterols and waxy matter. It was then

made basic with ammonia and extracted with chloroform. The chloroform extract was dried and evaporated to yield a brown gum, which did not give a precipitate with Meyer's reagent but gave an orange-red precipitate with potassium bismuth iodide. It developed dark red colour on boiling with acetic anhydride, which was an indication that the base was present in the form of N-oxide. On reduction it yielded the free tertiary amine. The chloroform did not extract the N-oxide completely, because when the remaining basic solution was made strongly acidic with 2N sulphuric acid and stirred with zinc dust so as to reduce any unextractable N-oxides, rendered basic and extracted with chloroform, it gave more of the product. Paper chromatography (ascending) using different solvent systems gave identical spots with both fractions of the tertiary amine showing that only one alkaloid was present wholly as N-oxide. Hence in the further extractions the aqueous acidic solution was reduced straight away to the corresponding tertiary amine and used for further study.

The base was a viscous oil (b.p. 104-106°/10⁻⁵ mm.), $[\alpha]_D^{25} = +36.45^\circ$ (CHCl₃) and refractive index 1.51. All attempts to crystallise the base were unsuccessful.

The infra-red spectrum (in nujol) of the base showed absorption at 3400 cm.⁻¹ (OH) and a weak absorption at 1670 cm.⁻¹ (>C=CH-). The N.M.R. spectrum (in CCl₄) gave signals at δ 3.3 (methoxyl protons) and at δ 5.5 (olefinic protons). It was converted into picrate which crystallised from absolute ethanol as yellow needles, m.p. 156-157° (d). (C, 45.4; H, 5.0; N, 14.0; OCH₃, 7.1%; C₉H₁₅NO₂.C₆H₃N₃O₇ requires C, 45.2; H, 4.5; N, 14.0; OCH₃, 7.8%). It does not contain C-methyl group.

The base on refluxing with hydrobromic acid (78%) yielded a hydrobromide which crystallised from absolute ethanol-ether as colourless prisms, m.p. 171-173° (C, 32.6; H, 4.8; N, 4.6; Br, 50.8%; C₈H₁₂NOBr.HBr requires C, 32.1; H, 4.3; N, 4.7; Br 53.5%).

The base C₉H₁₅NO₂ has therefore one methoxyl and one alcoholic hydroxyl (sec); its properties and behaviour do not agree with any of the known nectines containing methoxyl groups.⁶ Further study of this base occurring as N-oxide (C₉H₁₅NO₃) in this plant is under progress. Though the base is present upto 0.2%, it may not be toxic to animals because it is in the nectine form, which is considered to be not as toxic as the ester form.

Department of Chemistry, R. N. GANDHI.
University of Delhi, T. R. RAJAGOPALAN.
Delhi-7, August 24, 1966. T. R. SESHADRI.

1. *The Wealth of India*, C.S.I.R., New Delhi, 1950, 2, 382.
2. Singh, C. P. and Talapatra, S. K., *Indian J. Dairy Sci.*, 1963, 16, 53.
3. Mehta, C. R. and Rana, N. G., *Indian J. Pharm.*, 1958, 20, 361.
4. Sethi, M. L. and Atal, C. K., *Ibid.*, 1963, 25, 159.
5. Rajagopalan, T. R. and Seshadri, T. R., *Curr. Sci.*, 1964, 33, 163.
6. Culvenor, C. C. J. and Smith, L. W., *Aust. J. Chem.*, 1962, 15, 121.

PYRIDINE-2-ALDOXIME—A NEW COMPLEXING AGENT FOR THORIUM

RECENTLY several complexes with the bidentate ligand, pyridine-2-aldoxime have been reported.^{1,2} In a study of Cu (II), Pt (II) and Pd (II) pyridine-2-aldoxime complexes³ it was suggested that it was an unsymmetrical chelating agent. In a study of Cu (II) complexes⁴ it was shown that pyridine-2-aldoxime could behave as a bidentate ligand with or without the loss of the oxime proton. In a 2 : 1 complex the four nitrogen atoms were arranged in a square-planar fashion and the complex may assume either the *cis*- or *trans*-configuration. In the *cis*-configuration the oxime groups are arranged as much as they were in dimethylglyoxime complexes. It seems in this case the intramolecular hydrogen bonding may occur to form a pseudo six-membered ring system and further stabilise the complex.

Pyridine-2-aldoxime was obtained from Aldrich Chemical Co., Milwaukee, Wisconsin, U.S.A. It was used without further purification.

To a solution of thorium nitrate in 20 ml. of absolute alcohol [obtained from a weighed amount of thorium oxide (99.9% pure) in A.R. nitric acid] was added a calculated quantity of pyridine-2-aldoxime in 50 ml. of absolute alcohol. The resulting solution was carefully evaporated on a steam-bath when a green solid complex separated (m.p. 88°). The green solid was treated with benzene to remove any excess ligand, purified from methanol and vacuum-dried. It was shown (a weighed amount of the dried chelate was ignited in a platinum crucible and the residual oxide weighed) that the metal to ligand ratio is 1 : 4.

Spectra Data.—In the ultra-violet region pyridine-2-aldoxime exhibits two absorption maxima at 275 m μ (log ϵ 3.9) and 240 m μ (log ϵ 4.03) in water and only one at 250 m μ (log ϵ 4.1) in the solvent ethanol. The chelate exhibits two absorption maxima in the

solvent water at 280 m μ (log ϵ 4.24) and 235 m μ (log ϵ 4.4). In the solvent ethanol only one maximum could be located at 245 m μ (log ϵ 4.4).

In the visible region the ligand has got no characteristic absorption in the solvents investigated while the chelate has an absorption maximum at 620 m μ (log ϵ 1.8) in water and at 640 m μ (log ϵ 0.98) in ethanol.

The infra-red absorption bands of pyridine-2-aldoxime and its metal complexes were recorded⁵ and assignments for C=N, N—O stretching and four pyridine ring bands have been assigned for the complexes investigated. The 2-substituted pyridine ring should give rise to four ring stretching frequencies⁶ between 1620 and 1425 cm.⁻¹. Normal oximes^{7,8} have bands at 3300–3150 cm.⁻¹ (O—H stretch), 1690–1620 cm.⁻¹ (C=N stretch) and a band near 950 cm.⁻¹ (N—O stretch). In the present investigation the four ring stretching frequencies have been located in the ligand and the chelate between 1650–1400 cm.⁻¹. A fifth band located near 1500 cm.⁻¹ in the chelate and the ligand could be assigned to be C=N vibrational frequency. The N—O stretch frequency normally located in oximes around 955 cm.⁻¹ could, however, be located with sharp medium intensity in the ligand. In the chelate now investigated there is a broad band around 960 cm.⁻¹ and could be assigned to N—O stretch frequency. The band located around 3250 cm.⁻¹ in the ligand and the chelate is due to the O—H frequency.

The authors are grateful to Prof. N. V. Subba Rao for his keen interest and encouragement. One of the authors (V. R. R.) is grateful to the Council of Scientific and Industrial Research, New Delhi, for financial assistance.

Dept. of Chemistry, P. RADHAKRISHNA MURTHY.
Osmania University, V. RAMACHANDRA RAO.*
Hyderabad-7, April 1, 1966.

* Present Address : Department of Chemistry, Marathwada University, Aurangabad.

1. Krause, R. A. and Busch, D. H., *J. Am. Chem. Soc.*, 1960, 82, 4830.
2. *Pyridine-2-aldoxime Complexes of Rare-Earths*, P. Radhakrishna Murthy and V. Ramachandra Rao, communicated.
3. Liu, C. F. and Liu, C. H., *Proceedings of the Sixth International Conference on Co-ordination Chemistry*, Detroit, Michigan, 1961, p. 664.
4. Green, R. W. and Svasti, M. C. K., *Aust. J. Chem.*, 1963, 16, 356.
5. Krause, R. A., Colthup, N. B. and Busch, D. H., *J. Phys. Chem.*, 1961, 65, 2216.
6. Katritzky, A. R., *Quart. Revs. (Lond.)*, 1959, 13, 353.
7. Fabian, J., Legrand, M. and Poirier, P., *Bull. Soc. Chim. France*, 1956, 23, 1499.
8. Brown, J. F. Jr., *J. Am. Chem. Soc.*, 1955, 77, 6341.

INFRA-RED ABSORPTION SPECTRA OF THIOCYANATO COMPLEXES OF MANGANESE (II)

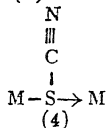
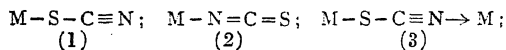
As a part of our investigations on transition metal complexes, we reported earlier thiocyanato complexes of divalent manganese.¹ The thiocyanate ion can co-ordinate to the metal either through nitrogen or sulphur. The infra-red absorption spectra of these compounds pertaining to the thiocyanate co-ordination are now reported (Table I), on Nujol mulls using Unicam SP 200 spectrophotometer with rock salt optics which show definite evidence for nitrogen co-ordination.

TABLE I

I.R. absorption frequencies and band assignments in thiocyanato complexes of Mn(II) (cm.⁻¹)

Mn (Pr.) ₄ (NCS) ₂	Mn (IQ) ₄ (NCS) ₂	Assignment
815 (S) 2100 (VS)	860 (VS) 2100 (VS)	ν (C-S) ν (C-N)
S—Sharp; IQ—Isoquinoline.	VS—Very sharp;	Py—Pyridine;

The thiocyanate group can be co-ordinated in at least four ways as shown below:



The structures represented by 1, 2 and 3 have been established by crystal structure determination. Mitchell and Williams suggested² that the order of the $\text{C}\equiv\text{N}$ stretching frequency is $\text{M-N}=\text{C}=\text{S} \leq \text{M-S-C}\equiv\text{N} < \text{M-S-C}\equiv\text{N}\rightarrow\text{M}$. According to Chatt and Duncanson,³ the bridging SCN group absorbs near 2182–2150 cm^{-1} whereas the terminal SCN group absorbs at 2120–2100 cm^{-1} and this is in accordance with the above suggestion. It is clear from the results in Table I, that there are no bridging SCN groups in these complexes since they absorb at 2100 cm^{-1} . Recently, it was pointed out⁴ that C—S stretching frequency is more diagnostic, since in S-bonded complexes, it occurs at 690–720 cm^{-1} and in N-bonded complexes at 780–860 cm^{-1} . The I.R. spectra of thiocyanato palladium and platinum complexes were recorded,^{5,6} where it was observed that the $\text{C}\equiv\text{N}$ stretching mode was raised from 2055 cm^{-1} for the free ion to 2085–2095 cm^{-1} in N-metal complexes and to 2100–2125 cm^{-1} in S-metal complexes. Similarly, the C—S stretching frequency was raised from 749 cm^{-1}

in the free ion to 780–860 cm^{-1} in N-metal complexes but is lowered to 690–720 cm^{-1} by co-ordination through sulphur. All these observations were in accordance with the change to be expected in relevant bond orders. Viewed from this earlier literature, the results in Table I reveal that in the complexes now reported, the thiocyanate is linked to the metal through nitrogen but not through sulphur. This is in conformity with the X-ray analysis data⁷ that the first row transition metals usually form M—N bonds with thiocyanate ion.

Department of Chemistry, K. C. DASH.
Regional Engg. College, D. V. RAMANA RAO.
Rourkela-8 (Orissa), March 25, 1966.

1. Dash, K. C. and Ramana Rao, D. V., *Ind. J. Chem.* (In press).
2. Mitchell, P. C. H. and Williams, R. J. P., *J. Chem. Soc.*, 1960, p. 1912.
3. Chatt, J. and Duncanson, L. A., *Nature*, 1956, 178, 997.
4. Lewis, J., Nyholm, R. S. and Smith, P. W., *J. Chem. Soc.*, 1961, p. 4590.
5. Tramer, A., *J. Chem. Phys.*, 1962, 59, 232.
6. Turco, A. and Pecile, C., *Nature*, 1961, 191, 66.
7. Brown, E. W. and Lingafelter, E. C., *Acta Cryst.*, 1963, 16, 753.

INVESTIGATIONS ON SOME AMINO COMPLEXES OF COBALT (II) PHTHALIMIDE

Part III. Visible Absorption Measurements

THE preparation, preliminary investigations and infra-red spectra of some amine complexes of cobalt (II) phthalimide have been reported.^{1,2} The present note relates to the visible absorption spectrophotometric measurements, in order to further confirm the structure of cobalt (II) complexes.

The spectra were recorded on a Unicam S.P. 500 spectrophotometer at a concentration of 10^{-2} M in formamide. The spectral maxima are recorded in Table I.

TABLE I

Compound	$^1\text{A}_2\rightarrow^4\text{T}_1(\text{P}) \text{ cm}^{-1}$	$^1\text{A}_2\rightarrow^4\text{T}_1(\text{F}) \text{ cm}^{-1}$
1. Biphthalimidobi (amino) cobalt (II)	18500 Sh, 18000	8900 Sh
2. Biphthalimido (ethylenediamine) cobalt (II)	18550 Sh, 18100, 18000 Sh	8950 Sh
3. Biphthalimido (2,2'-dipyridyl) cobalt (II)	18550 Sh, 18000, 17950 Sh	9050
4. Biphthalimido (O-phenanthro- line) cobalt (II)	18600 Sh, 18000	9050

Sh = Shoulder.

Cobalt (II) is a d^7 system and the level order is inverted in going from octahedral to tetrahedral co-ordination, the ground state is here $^4A_2 (e)^4 (t_2)^3$.

The comparison of the data with the work of Cotton *et al.*^{3,4} shows that the formamide solutions contain tetrahedral cobalt (II) species. The spectra also closely resemble those of the dichloro (bipyridylamine) cobalt (II) and related complexes.^{5,6} The fine structures of the $^4A_2 \rightarrow ^4T_1(P)$ band is caused by spin-orbit coupling which both splits the $^4T_1(P)$ state itself and allows the transitions to the neighbouring doublet states to gain some intensity.⁷ The band close to 7000 cm^{-1} has been assigned as $^4A_2 \rightarrow ^4T_1(F)$, because the assignment of the 7000 cm^{-1} band as $^4A_2 \rightarrow ^4T_2(F)$ would imply a value of Δ of $\sim 7000 \text{ cm}^{-1}$, which is much greater than that anticipated for cobalt (II) ions in tetrahedral co-ordination.⁸

Department of Chemistry, Gopal Narain,
Lucknow University,
Lucknow, India, February 19, 1966.

1. Gopal Narain, Padmaja Shukla and Srivastava, L. N., *J. Prakt. Chemie*, 1966, **31**, 123.
2. —, *Bull. Chem. Soc. Japan*, 1965, **39**, 2093.
3. Cotton, F. A. and Goodgame, M., *J. Am. Chem. Soc.*, 1961, **83**, 1777.
4. —, Faut, O. D., Goodgame, D. M. L. and Holm, R. H., *Ibid.*, 1961, **83**, 1780.
5. McWhinnie, W. R., *J. Inorg. Nucl. Chem.*, 1965, **27**, 1619.
6. Ahuja, I. S., Brown, D. H., Nuttal, R. H. and Sharp, D. W. A., *Ibid.*, 1965, **27**, 1625.
7. Cotton, F. A. and Wilkinson, G., *Advanced Inorganic Chemistry*, Interscience Publishers, U.S.A., 1962, p. 726.
8. Ballhausen, C. J., *Introduction to Ligand Field Theory*, McGraw-Hill, New York, 1962, p. 258.

POLYPHENOLASE ACTIVITY IN *TRIBOLIUM CONFUSUM* DUVAL

THE polymerized lipoprotein is known to be the main constituent of insect cuticulin¹ and on it lies a complex of guinanoid structure firmly bound to the protein moiety of the cuticulin.² The previous studies revealed that these quinoid strata are highly polymerized polyphenols, subsequently oxidized to quinones. How the polyphenolic compounds are synthesized and deposited are not well understood. While studying the ultra-violet absorbancy at different wavelengths (210 to 600 $\text{m}\mu$) of free nucleotides extracted from *Tribolium confusum* Duval at the various stages of its life-cycle, Devi *et al.*,³ based on the observed differences in free nucleotide contents, obtained from optical density method and chemical methods, suggested

that the discrepancy of the results can be best explained if the appearance of a phenolic compound or compounds at the insect body, at the later stage of the pupal life and at all stages of life thereafter is assumed. Subsequently this compound was characterized as catechol by TL chromatography and infra-red spectroscopy studies.⁴ The appearance of catechol during pupal and earlier stages of adulthood appears to correspond with the cuticulin formation in the insect, indicating the occurrence (or synthesis) of an enzyme or a group of enzymes (polyphenol oxidases) in *T. confusum* Duval during this period in the life-cycle of the insect. The present work was undertaken to establish the occurrence of these enzymes and their role in cuticulin formation. The results are reported in this short communication.

Insects at their various stages of life-cycle were used for this investigation, *viz.*, eggs 1 to 4 days; larva 4 to 6 and 9 to 12 days; pupa 1 to 4 and 12 to 14 days; adults 8 to 10 days. For details, see reference 3. Approximately 100 to 150 gm. of washed, cleaned and dried insects were homogenized in water with an all-glass ball-type of homogenizer at 0-2° C., filtered through four layers of fine cheese cloth and then centrifuged for 2 minutes at 600 $\times g$. at 0° C. to remove cell debris.

Sodium salt of EDTA, ascorbic acid (free) were purchased from Sigma Chemical Company; catechol, dihydroxyphenyl alanine (DOPA), l-tyrosine from Mann Research Laboratories, Inc.

The tyrosinase activity was determined by the method of Yasunobu⁵ which measures the decrease in optical density of ascorbate at 265 $\text{m}\mu$ that results from the oxidation of the substrate by the enzyme. The substrate used was tyrosine (catechol or dihydroxyphenyl alanine) in a total volume of 3 ml. The reaction mixture contained 7×10^{-6} M ascorbate, 1.5 μM disodium salt of, ethylene diamine tetraacetic acid (EDTA) and 2×10^{-2} M of the substrate. The final volume was made up with 0.1 M phosphate buffer pH 6.0. All reagents were made in phosphate buffer of the same concentration and pH. Ascorbic acid and the substrate solutions were prepared just prior to their use. The reaction mixture was incubated at 37° C. for 10 minutes and was terminated by adding 3 ml. of 10% perchloric acid to it. The optical density of the centrifuged supernatant was measured at 265 $\text{m}\mu$ in a Beckman Spectrophotometer (model DU), against the same concentration of PCA. The enzyme and substrate controls were also run along with the experimentals. The

enzyme unit (arbitrary) is based on the extent of oxidation of ascorbic acid by the enzyme present in 1.0 g. of insect in one hour at 37.5° C., making necessary allowances for auto-oxidation of ascorbic acid and oxidation of the latter by tissue ascorbic acid oxidase.

Recently Susselman⁶ pointed out some advantages of using ferrocyanide as the reducing agent instead of ascorbic acid for the assay of the enzyme in *Nurospora crassa*. In the present work ascorbic acid was preferred to ferrocyanide since the latter interferes with the assay procedure. The protein content was determined by biurate reaction.⁷

The changes in the activities of tyrosinase, DOPA oxidase and catecholase at the different stages of life-cycle of *Tribolium confusum* Duval are shown in Fig. 1. The tyrosinase

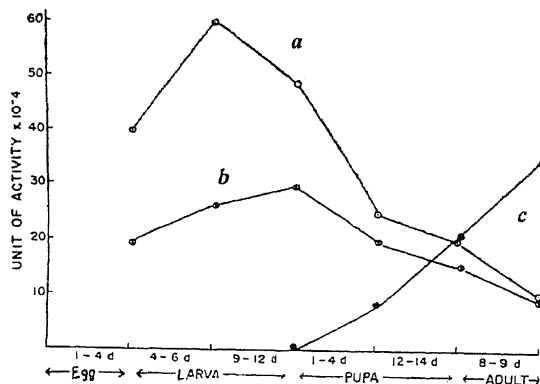


FIG. 1. Polyphenolase activity of *Tribolium confusum* Duval: The reaction mixture containing in a total volume of 3 ml. 7×10^{-6} M ascorbate, 1.5 ml. EDTA, $0.5 \text{ ml. } 2 \times 10^{-2}$ M tyrosinase and 20 μM phosphate buffer at pH 6.0, incubated at 37° C. for 30 mins. The reaction was terminated by adding 3 ml. of 10 % TCA. The unit of activity was measured as the degree of oxidation of ascorbate per gram of insects per hour.

○—Tyrosinase, ⊗—DOPA oxidase, ●—Catecholase.

activity (curve a) which is either absent or very low in embryonic stage (eggs) becomes evident at the early stage of larva, then begins to increase until it attains the maximum between 7 to 9 days after hatching. The activity begins to decline thereafter, which continues until it reaches the minimal value during the beginning of the adulthood life. The enzyme (curve b) which catalyzes the degradation of DOPA also seems to appear at larval stage, its activity increases steadily to a peak at the earlier stage of pupal life, then like tyrosinase begins to decline to a minimal value. The patterns of the changes in the activities of these two enzymes are similar in nature, but the activity of DOPA oxidase is consider-

ably less than that of the tyrosinase up to the end of the first part of pupal life, which narrows down with age.

An entirely different pattern of changes in the activity of catecholase is noted, with the variations in the various stages of the life-cycle of the insect (curve c). The appearance of this enzyme occurs at the late pupal stage, steadily increases thereafter with the increase in age.

Since from the study of the variations in the activities of the first two enzymes, viz., tyrosinase and DOPA oxidase with the changes in age of the insect, i.e., during the various stages of the life-cycle of *T. confusum* Duval, it is evident that these two enzymes are more active at larval stage and considerably much less so at adult stage, than any other period of the life-cycle of the insect; they may be considered as enzymes concerned with processes of maturation.⁸ The appearance of catecholase activity on the other hand occurs at the time when the activities of the first two enzymes begin to decline. It might be considered indicative of its function at a later stage of life-cycle of the insect (adult stage of life) and may therefore be classified as functional enzyme.⁸

The changes in enzyme activity with age have been previously noted by many workers in mammalian and avian livers.⁸⁻¹¹ It is possible that the synthesis of these enzymes occurs when necessity demands providing the cell with a better organizational economy. Whether or not they are actually synthesized during the period when they are most active is now under investigation.

Department of Biochemistry, ANIMA DEVI.
Punjab Agricultural University,
Ludhiana, Punjab, March 9, 1966.

1. Wigglesworth, V. E., *Quart. J. Microscop. Sci.*, 1948, **89**, 197.
2. Dannell, R. and Malek, S. R. A., *Proc. Roy. Soc. (London)*, 1955, **143 B**, 239.
3. Devi, A., Lemonde, A. and Sarkar, N. K., *Exptl. Cell Res.*, 1963, **29**, 443.
4. Patil, F. V., Devi, A., Mukundan, M. A. and Sarkar, N. K., *Experientia*, 1963, **19**, 344.
5. Yasunobu, K. T. and Norris, N. R., *J. Biol. Chem.*, 1955, **227**, 473.
6. Sussman, S. A., *Arch. Biochem. Biophys.*, 1961, **95**, 407.
7. Lowry, C. H. et al., *J. Biol. Chem.*, 1951, **193**, 265.
8. Richter, D., *Brit. Med. Bull.*, 1961, **17**, 118.
9. Mukundan, M. A., Devi, Anima and Sarkar, N. K., *Biochem. Biophys. Res. Commun.*, 1963, **11**, 353.
10. —, — and —, *Exptl. Cell Res.*, 1963, **32**, 251.
11. Thind, S. K., Singh, Anupinder and Sarkar, N. K., *J. Gerontol.*, 1966, **21**, 93.

STUDIES ON BOMBAY RATS

A Note on the Field Trial of Ratticides in
Bait Boxes

In two previous papers^{1,2} the author reported tests on some available ratticides in India for controlling rats, and use of bait boxes to control fleas. Results of further field trials of these conducted recently in three districts of Maharashtra State are summarised in this note. The experiments were done for 68 days wherein 2,772 rats were caught and 9,042 fleas recovered. 400 wonder traps, 138 bait boxes, 2260 gm. of

in rat density in the trials. It was seen that very few rats were collected dead after the trial with shoxin and rodafarin. This is because, one is a specific poison killing only certain species of rats, and showing no reduction when those species are absent. That is why at Risama in this table for shoxin, there has been no reduction. In the case of rodafarin, the rats normally die after 4 days and may continue for 10 days. This spread gives very few rats in the collection. In the case of zinc phosphide, the mortality and dead rats are available for results the very next morning.

TABLE I
Field trials with ratticides

Name of place	No. of days of duration of experiments	Concentration used	No. of houses where experiments were done	Initial rat density	Post-baiting rat density	Actual No. of rats collected dead	Remarks
Zinc phosphide							
Risama	4	1%	30	23.0	3.0	7	Including days of pre-baiting
Sakoli	5	1%	40	127.5	12.5	12	
Kardha	5	1%	40	75.0	7.5	12	
Kamptee	5	0.1%	25	80.0	8.0	17	
Kanhan	5	0.1%	60	190.0	No rat	80	
				Shoxin			
Risama	4	0.0.5%	30	36.6	40.0	Nil	
Sakoli	5	"	40	122.5	25.0	"	
Kardha	5	"	40	75.0	7.5	"	
Kamptee	5	"	25	48.0	28.0	"	
				Rodafarin			
Gopalpur	6	0.025%	100	27.0	14.0	12	
Nagbhir	10	"	100	51.4	38.0	18	
Chandrapur	12	"	100	82.5	36.6	2	

shoxin, 5,438 gm. of zinc phosphide, 1,0545 gm. of rodafarin and 6600 gm. of 5% B.H.C. dust were used in these experiments.

Shoxin was used at 0.5%, rodafarin (a locally available anticoagulant) at 0.025%, and zinc phosphide at 1% and 0.1%. The first bait was used as a readymade powder supplied by W.H.O and also as paste on dry food grains. Rodafarin was made available mixed at 0.025% in crushed food grains and zinc phosphide was used on whole wheat grains. In case of shoxin and zinc phosphide the baits were put for 2 days and in the case of rodafarin from 6 to 19 days. The wooden bait boxes were dusted with 5% B.H.C. at 10 gm. per box and laid out for prebaiting for two days prior to baiting with the ratticides. The initial rat density of the areas was taken by wonder traps and at the same time the initial flea index was also taken. After baiting, rats were again collected by traps to find out the reduction in rat and flea indices.

Table I gives an indication of the reduction

Table II shows the initial and post-reduction flea index by using 5% B.H.C. dusted in bait boxes. The reduction in the index was seen even after 5 days. During the trial of Rodafarin which lasted for more than 10 days, the indices taken after this period do not show a continuance of reduction, as, much of this may have gone away with the rats entering and re-entering; further when the number of rats gets reduced in the total collection the index on this small number of rats gives an erroneous figure, as is seen for the figures of Chandrapur.

From Tables I and II it will be seen that zinc phosphide as a ratticide used in bait boxes has given consistent mortality in rats, and there has been a reduction in the flea indices due to the B.H.C. dust in the bait box. The other two ratticides do not compare well with zinc phosphide. The reduction in flea indices shows that the incorporation of the insecticide powder in the bait box will serve the dual purpose; i.e., reduction of fleas during prebaiting and the

TABLE II

Reduction in flea indices by insecticide dusted
bait boxes—dusting of 5% B.H.C. at 10 gm.
per box

Place	No. of bait boxes used	Initial rat density	Initial flea index	Post-baiting flea index	Post-baiting rat density	Remarks
Khardha ..	50	75.0	4.4	0.5	7.5	Post-baiting
Kamptee ..	25	48.0	11.0	4.0	28.0	flea index
Khardha ..	50	75.0	3.3	1.0	7.5	taken after
Kamptee ..	50	80.0	16.0	4.0	8.0	5 days
Kanhan ..	40	190.0	2.5	0	0	
Gopalpur	100	27.0	1.6	1.5	14.0	After 9 to 12
Nagbhir ..	100	51.4	2.5	1.6	38.0	days
Chandrapur	100	82.5	3.8	5.0	36.6	

reduction of rats by the poison which is kept safely, during the baiting operations. The box further reduces the risk of accidental poisoning by domestic animals or human beings.

We are thankful to W.H.O. for the supply of shoxin, to Messrs. Pest Control for rodafarin, to the Director of Public Health, Government of Maharashtra, for assistance, and to my colleagues Mr. Chaturvedi and Mr. Renapurkar for their untiring efforts in the execution of the project.

Haffkine Institute, P. J. DEORAS.
Bombay-12, March 17, 1966.

1. Deoras, P. J., *Curr. Sci.*, 1963, **32**, 457.
2. —, *Ibid.*, 1965, **34**, 348.

SHELL-LIKE FORMS IN THE BASAL STAGE, VINDHYAN SYSTEM

THE sedimentary rocks of the Vindhyan System have been examined by many workers for the possible existence of life during this period. Some promising indications occur in the form of algal structures which have been described by Mathur,² and Misra and Awasthi.⁴ Apart from this, certain doubtful fossils have been brought to light by Misra⁵ from the Suket shales, Rode⁶ from the Rohtas limestone, and pseudo-fucoids by Vredenburg.⁷ An important evidence of the presence of coaly matter discovered by Mathur³ in the shales of the Basal stage perhaps suggests grounds for a re-thinking on the age of these formations, which are so far considered to be of the Proterozoic. The shell-like forms observed by the writer in the carbonate rocks of the Basal stage (Lower Vindhyan) resemble broken brachiopod remains which are now described.

The shell-like form (Photo 1) was found to occur in a shaly limestone bed within the

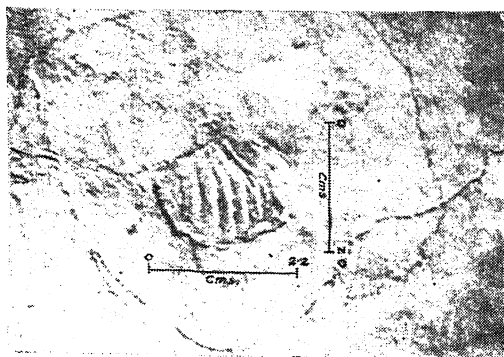


PHOTO 1. Shell-like form with ornamentations.

Kajrahat limestone (Auden¹). The bed forms a part of a shaly limestone member which occurs as a persistent mappable zone immediately north of the high limestone hills north of the Kajrahat village in Mirzapur District. In the specimen collected, the structure has a fossil shell form which appears to be embedded on the top of a bedding surface with its convex side facing up. On the same bedding surface, broken concentric (Stromatolite?) fragments and a similar concave shell-like casts were noticed. The form has the appearance of a broken cast of a brachiopod shell. Photo 1 (approximately natural size) resembles a lamp-shell shape with a lower convex valve-like structure with lamellar, simple or paired ornamentations. The lamellæ-like frills die out towards the base of the structure which may represent the hinge line in case this is a brachiopod. The top of the structure is formed of a vaguely concave depression with the shape of a flattened ellipsoid. It is possible that in case this structure had been found associated with known fossiliferous rocks, there would have been a likelihood of its identification as a fossil, and perhaps also a brachiopod. However, as it occurs in the oldest Vindhyan rocks, and has only been observed at one single locality, the evidence is to be treated with reservations.

Some thin sections of the more argillaceous carbonate rocks of the Kajrahat limestone show certain concave spiny forms with vague internal structures, and which under crossed nicols show high order grey polarisation colours (Photo 2). The forms suggest that these may be cross-sections of shells. At the suggestion of Dr. Krishna Mohan, some fresh samples of carbonate rocks from the above-mentioned

member were tested in the field for phosphate by using ammonium molybdate (4%) in 25% nitric acid, benzidine solution (0.1%) in 10% acetic acid and sodium acetate crystals. Some samples showed typical blue colourations due to the phosphate which may be an evidence for the possible existence of shelly matter.

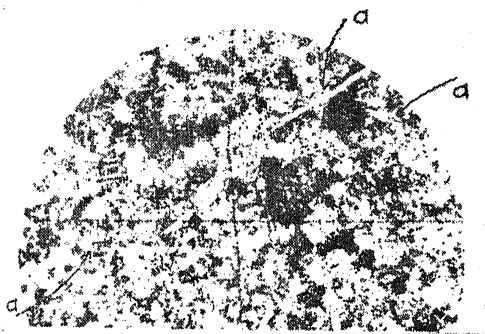


PHOTO 2. Broken spiny forms (a) in thin section.

The other more commonly occurring structures in the limestone beds are yellow-weathering flat to plano-convex forms, somewhat larger and similar in shape to the structure in Photo 1. Ornamentations in these, which are only evident when observed through a hand-lens, consist of concentric striations often with minute spiny structures. These forms, due to their typical weathering, can usually be spotted from a distance.

The present evidence is *not* considered sufficient to conclude that the structure is actually a fossil of a shell. However, its form coupled with the fact that it does appear to be a foreign body which is partly broken up and is embedded within the rock does suggest that it may be a fossil shell fragment. The sample is being taken up for a detailed study.

I wish to thank Dr. K. K. Misra of the D. X. Sun Ray Oil Company, U.S.A., for helpful discussions in the field and to Dr. Krishna Mohan, the ex-Director of Geology and Mining, U.P., for his suggestions.

Directorate of Geology and Mining, Lucknow, March 21, 1966. RAVI PRAKASH.

EFFECT OF SEROTONINE ON THE PIGMENT MIGRATION IN THE RED CHROMATOPHORES OF *GELASIMUS ANNULIPES*

THE spectacular colour displays exhibited by crustaceans have attracted the interest of biologists since the middle of the nineteenth century. Early investigators believed that pigment migration in crustaceans was mediated by nerves. Koller¹ presented first evidence that blood-borne substances were involved in crustacean colour changes. Perkins² found that denervation of a portion of the skin of *Palæmonetes* had no effect on the chromatophores. Since these early efforts, the crustacean chromatophore systems have been investigated in detail and it is generally known that the colour change in crustaceans is regulated by hormones. Fingerman³ presented a review of the work so far done on crustacean colour changes. While extensive work has been done on the effect of drugs on chromatophores of vertebrates, this type of investigation has scarcely been attempted in crustaceans. Beauvallet and Veil⁴ tested adrenaline on *Palæmon* which had darkened the animals. Abramowitz and Abramowitz⁵ could not observe any change in the melanophores of *Uca* after injecting adrenaline. In the present investigation the effect of serotonin on the red chromatophores of *Gelasimus annulipes* was studied as no work has been done so far on this crustacean.

Gelasimus annulipes used in the present investigation were collected from Vellar estuary and the experiments were carried out at the Marine Biological Laboratory, Porto Novo. As soon as the specimens were brought to the laboratory they were kept in estuarine water for 24 hours before they were utilized for the experiment. In order to study the effect of serotonin on the red chromatophores of *Gelasimus*, normal animals adapted to black background and eyestalkless individuals were used. The pigment in all the red chromatophores of black background adapted animals is dispersed while it is concentrated in the eyestalkless specimens.⁶ The red chromatophores were staged according to the system of Hogben and Slome.⁷

For each experiment 40 animals were selected at random from the stock aquarium; for 20 animals the eyestalks were ablated one day prior to the beginning of the experiment and then divided into two batches of 10 each. One batch was injected with 5 µg./crab serotonin while the other received sea-water injections (control).

1. Auden, J. B., *Mem. Geol. Surv. India*, 1933, **62**, Part 2.
2. Mathur, S. M., *Curr. Sci.*, 1965, **34** (3), 84.
3. —, *Indian Minerals*, **18** (2), 158.
4. Misra, R. C. and Awasthi, N., *J. Sedimentary Petrology*, 1962, **32**.
5. Misra, R. C., *Curr. Sci.*, 1951, **20**, 223.
6. Rode, K. P., *Ibid.*, 1949, **15**, 247.
7. Vredenburg, E. W., *Rec. Geol. Surv. India*, 1908, **36**, Part 4, 241.

Similarly, 20 animals were adapted to black background for 3 hours and then divided into two lots; one lot received the injection of serotonin while the other received sea-water injections. The observations were made at 15-minute intervals upto two hours. All the experiments were repeated once and the results are presented in Table I.

TABLE I

Effect of Serotonine on the red chromatophores of Gelasimus annulipes

(Each reading is average of 20 animals)

Time in minutes	Chromatophore stage			
	Eystalkless animals		Black background adapted forms	
	Injected with Serotonine	Injected with sea-water	Injected with Serotonine	Injected with sea-water
0 (Before injection)	1.3	1.5	3.8	4.0
15	3.0	1.5	3.8	4.0
30	3.5	1.5	3.9	4.0
45	4.0	1.6	4.0	4.0
60	4.0	1.5	3.8	4.0
75	3.8	1.6	3.8	4.0
90	3.5	1.5	3.8	4.0
120	3.5	1.5	3.8	4.0

From Table I it is evident that in eystalkless animals a dose of 5 µg. serotonin caused a distinct pigment dispersion in the red chromatophores. However, no visible effect in the red pigment concentration has been observed in the animals adapted to black background. Burgers⁸ also noticed only pigment dispersion in the prawn, *Leander serratus* by injecting serotonin. Welsh and Moorhead⁹ reported the occurrence of serotonin in crustacean nervous system. These findings suggest that serotonin may play a part in the regulation of the pigment dispersing reaction in the red chromatophores of crustaceans.

Zoology Department, R. NAGABHUSHANAM.
Marathwada University,
Aurangabad, November 30, 1965.

1. Koller, G., *Z. vergl. physiol.*, 1927, **5**, 191.
2. Perkins, E. B., *J. Exp. Zool.*, 1928, **50**, 71.
3. Fingerman, M., *The Control of Chromatophores*, Pergamon Press, Oxford, 1963.
4. Beauvallet, M. and Veil, C., *C. R. Soc. Biol., Paris*, 1934, **117**, 688.
5. Abramowitz, A. A. and Abramowitz, R. K., *Biol. Bull. Woods Hole*, 1938, **74**, 278.
6. Nagabhushanam, R., *Indian J. Exp. Biol.*, 1964, **2**, 69.

7. Hogben, L. T. and Slome, D., *Proc. roy. Soc. Lond.*, 1931, **108 B**, 16.
8. Burgers, A. C. J., *Acta Physiol. Pharmacol. Neerlandica*, 1963, p. 12.
9. Welsh, J. H. and Moorhead, M., *J. Neurochem.*, 1960, **6**, 146.

CHEMICAL INVESTIGATION OF ROOT-BARK AND STEM-BARK OF ALANGIUM LAMARCKII THWAITES— A CORRECTION

In the June 5 issue of your reputed journal Salgar and Merchant¹ observed, "Although the root-bark and the stem-bark of the above plant have been investigated by other workers, we were unable to get any alkaloids reported by them from the material we had at our disposal" and referred to two of our publications^{2,3} along with those of others while reporting the same alkaloid (tubulosine) isolated and published³ by me in 1964.

Even though I code-named the same alkaloid as AL 64, its identity with tubulosine was revealed a year ago (July, 1965) by Djerassi and his collaborators⁴ in the following words: "... an alkaloid isolated by Pakrashi³ together with emetine and related bases from *Alangium lamarckii* Thw. (family Alangiaceae) was identical with tubulosine. Through the courtesy of Dr. Pakrashi³ we were provided with a sufficient quantity of tubulosine to permit further chemical studies." It is pertinent to mention that this paper followed the one on the same subject in which Drs. Salgar and Merchant were co-authors.⁵ The reason that I did not disclose the identity myself with the full knowledge of it was that Dr. H. Budzikiewicz (Stanford) actually established it by mass spectrometric studies and I considered it to be unethical to publish under my own name alone. So far as I know from their own publication,⁵ the identity of desoxytubulosine was also suggested to Dr. Merchant by Dr. Budzikiewicz by mass spectral study.

As regards our report² on the isolation of emetine, cephaeline and psychotrine from the root-bark, it is highly improbable that we could have made a mistake. Our pioneering work,^{2,6} in establishing the unexpected presence of ipecac alkaloids in the seeds of *A. lamarckii*, was also recognised by these authors.⁷ However, contrary to the impression one would get from their latest publication,¹ it should clearly be understood that N-methylcephaeline has not yet been found to occur as such in the plant but could be obtained in highly crystalline state by N-methylation of the crude mixture of

ipecac alkaloids. While the variation of alkaloidal contents in plants with the habitat and season of collection is not uncommon, it is somewhat surprising that cephaeline, the major alkaloid of the root-bark in the Bengal variety we worked with, would be completely absent in the materials used (presumably South Indian variety) by Salgar and Merchant particularly when it was present in the fruits used by them. No conclusion can however be drawn pending the identification of three other spots in TLC reported by them.¹

I should like to point out in this connection that the sterol, m.p. 288–89° reported by Salgar and Merchant⁷ from the fruits and much earlier to them by other workers,^{8,9} from the seeds is not a sterol at all. We have already identified¹⁰ it as betulinic acid—a triterpene acid, and isolated betulin, betulinaldehyde, lactone of betulinic acid (artefact?) and β -sitosterol as the neutral products from the light petroleum ether extract of the seed kernels, the details of which will be published elsewhere. Our work on stem-bark alkaloids will also be reported in due course.

Indian Institute of
Experimental Medicine,
Calcutta-32, July 8, 1966.

S. C. PAKRASHI.

1. Salgar, S. S. and Merchant, J. R., *Curr. Sci.*, 1966, **35** (11), 281.
2. Pakrashi, S. C. and Ghosh-Dastidar, P. P., *Ind. J. Chem.*, 1964, **2**, 279.
3. —, *Ibid.*, 1964, **2**, 468.
4. Monteiro, H., Budzikiewicz, H., Djerassi, C., Arndt, R. R. and Baarschers, W. H., *Chem. Comm. (London)*, 1965, p. 317.
5. Battersby, A. R., Merchant, J. R., Ruveda, E. A. and Salgar, S. S., *Ibid.*, 1965, p. 315.
6. Budzikiewicz, H., Pakrashi, S. C. and Vorbrüggen, H., *Tetrahedron*, 1964, **20**, 399.
7. Salgar, S. S. and Merchant, J. R., *Curr. Sci.*, 1964, **33**, 744.
8. Bhargava, P. N. and Dutt, S. B., *Proc. Ind. Acad. Sci.*, 1942, **16 A**, 328.
9. Lakshminarasimhaiah, A., Manjunath, B. L. and Nagaraj, B. S., *J. Mysore Univ.*, 1942, **3 B**, 113.
10. Pakrashi, S. C., Bhattacharyya, J., Mookerjee, S. and Vorbrüggen, H., *Abstr. Symp. Rec. Adv. Chem. Triterpenoids*, NCL, Poona, June 7–10, 1965, p. 37.

CHANGES IN PROTEIN QUANTITY AND QUALITY ASSOCIATED WITH A MUTATION FOR AMBER GRAIN COLOUR IN WHEAT

SEEDS of Sonora 63, Sonora 64 and Lerma Rojo 64, three dwarf wheat varieties developed in Mexico under a co-operative wheat improvement project sponsored by the Rockefeller Foundation and the Mexican Ministry of Agriculture, were

treated in 1963 with a wide range of physical and chemical mutagens for screening for mutations for grain colour and resistance to leaf rust. Sonora 63 and Lerma Rojo 64 have a single 'Norin gene'¹ for dwarfing, while Sonora 64 has two such genes. These have red grains and one of the objectives of the mutation breeding programme in these varieties was to obtain mutants with amber grain colour, since farmers in India prefer such grains. Extensive M₂ populations were screened during 1964–65 and several amber grain mutants were found both in treatments with gamma-rays and ethyl-methane-sulphonate (EMS). The seeds of these mutants were multiplied and selections were done for families which resembled the parent strains in all the other characters, except grain colour.

Two mutant families each in Sonora 63 and Sonora 64 and three in Lerma Rojo 64 isolated in gamma-ray-treated material, which had similar yielding ability, maturity period, plant height and ear characteristics as the controls were subjected to protein analysis during 1965–66 (Table I). In 5 different replicates,

TABLE I
Protein characteristics of amber grain mutants

Variety and culture number	Protein %	Gluten %	Mean Pelshenke value
A. Sonora 63			
Control	11.2	7.3	181
Amber mutant-1	16.4	13.6	175
" " 2	14.4	10.9	189
B. Sonora 64			
Control	12.4	8.7	180
Amber mutant-1	15.0	13.1	155
" " 2	14.5	12.9	141
C. Lerma Rojo 64			
Control	10.3	11.3	59
Amber mutant-1	15.2	14.3	73
" " 2	13.7	12.7	111
" " 3	13.7	13.1	91

the protein content was found to be consistently higher in the amber grain mutants. An increase in the gluten fraction largely contributed to the rise in protein quantity. However, this resultant gluten seems to be qualitatively different from the control, as the Pelshenke value, which is a measure of strength, was different in the different mutants. Lerma Rojo 64 is a soft wheat and hence the amber mutants with a higher Pelshenke value are of great applied interest.

Since the discovery of the opaque-2 and floury-2 genes in maize,^{2,3} there has been much interest in the identification of genes controlling amino-acid composition, associated with morphological markers.⁴ Changes in the gliadin:

glutenin ratio as well as in the amino-acid composition of any of the gluten fractions could be involved in the amber mutants isolated by us in wheat. There is evidence that there is a sharp increase in the amino-acids glutamic acid, phenylalanine and proline with an increase in protein content in wheat.⁵ The protein of the amber grain mutants of Sonora 63, Sonora 64 and Lerma Rojo 64 will shortly be tested for protein spectrum, amino-acid composition and biological value.

Crosses have been made between the mutants and the parents to examine whether the changes in grain colour and protein content are inherited as a single recombinational unit. Since in three different varieties, an increase in protein content occurred coincidentally with a change to the amber grain colour, it is likely that these two characters are either closely linked or involve genuine pleiotropism. So far, genes for grain colour and protein content have been identified in chromosomes 2A, 3B and 3D and 1D, 3D, 4D, 5A, 5B and 7B respectively.⁶ Monosomic analysis, currently underway, would help to identify the chromosome(s) concerned in the mutation for grain colour and protein content.

Indian Agricultural Research Institute,
New Delhi, August 23, 1966.

GEORGE VERUGHESE.
M. S. SWAMINATHAN.

1. Everson, E. H., Muir, C. E. and Vogel, O. A., *Agron. J.*, 1957, **49**, 521.
2. Mertz, E. T., Bates, L. S. and Nelson, O. E., *Science*, 1964, **145**, 275.
3. Nelson, O. E., Mertz, E. T. and Bates, L. S., *Ibid.*, 1965, **150**, 1469.
4. Fukushi, Y. and Seki, T., *Japan. J. Genetics*, 1965, **40** (3), 203.
5. Frank, N., Hepburn and William, B. Bradley, *Cereal Chem.*, 1965, **42** (2), 140.
6. Morris, R., *Wheat Newsletter*, 1959, **6**, 2.

EMERICELLOPSIS SYNNEMATICOLA VAR. MAGNUS VAR. NOV.

A new variety of *Emericellopsis synnematicola* var. *magnus* is described and figured. It differs from all the described species in bearing very large cleistothecia and occasionally having branched conidiophores in the Stilbella stage.

During the course of the author's study of the rhizosphere mycoflora of some fodder grasses of U.P. in the Banaras Hindu University campus, the fungus was obtained. It appeared first on Martin's rose bengal medium producing large coremia. A few dark globular ascocarps appeared after two weeks. The cultural characters are:

Coloniae in agar Czapek-dox fermentaceo lente crescentes ad temperiem cubiculi, attinentes diam. 4 cm. post dies 15, albæ ad maturitatem producentes et coremia et cleistothecia. Hyphæ hyalinæ septatæ, vulgo immersæ, ad 2 μ latæ; corticia erecta uniformiter per coloniam distributa, ad 4 mm., alta, crenea, supportantia capitula conidialia mucosa eminentia; conidiophora simplicia vel ramosa; Conidia plura hyalina globosa vel subglobosa, 2.5-5 μ . Cleistothecia copiose producta, fusca, et superficialia et immersa, coloniam aspectu nigram efficientia, globosa, ornata parietibus eminentibus cellularum hyalinarum vel luteolarum ad 25 μ crassis, 40-375 μ diam. Asci rari vel plures, atri, globosi vel subglobosi, 10-14 μ , persistentes, octospori. Ascospore globosæ vel subglobosæ, in massa nigræ, singulæ vero brunneæ, ornatae vulgo 3, interdum 4, projectionibus brevibus cornutis, 5-7.5 μ ; projectiones sporam aspectu triangularem efficiunt, 1.5 μ longæ.

Typus lectus e solo in campo universitatis Benarasensis in India a K. M. Leelavathy mense januario 1965 et positus in I.M.I. Herbarium slale no. 113679.

Colonies on Czapek-Dox-Yeast agar slow-growing at room temperature, attaining a diameter of 4 cm. in 15 days, white, developing both coremia and cleistothecia at maturity, hyphæ hyaline, septate, mostly submerged, up to 2 μ broad; coremia erect, distributed uniformly in the colony; up to 4 mm. high, cream-coloured, bearing prominent slimy conidial heads; conidiophore simple or branched; conidia numerous, hyaline, globose to subglobose, 2.5-7.5 μ ; cleistothecia produced in abundance, dark, superficial as well as submerged, giving a black appearance to the colony, globose, with a prominent wall of hyaline or yellowish cells, up to 25 μ thick, 40-375 μ in diameter, asci few to numerous, black, globose to subglobose, black in mass, brown when single, 10-14 μ ; ascospores 5-7.5 μ , provided with 3 but sometimes 4 short horn-like projections; projections giving a triangular appearance to the spore in surface view while in profile they girdle the whole spore, having a length of 1.5 μ .

The fungus was isolated from soil from the B.H.U. campus by K. M. Leelavathy in January 1965 and is deposited in I.M.I. Herbarium No. 113679.

Emericellopsis synnematicola var. *magnus* differs from *E. synnematicola* Mathur and Thirumalachari¹ in the following respects:

1. Production of very large cleistothecia measuring up to $425\ \mu$ whereas the largest cleistothecia described so far measure up to $300\ \mu$ only.

2. Asci are persistent, intact ones being often observed when cleistothecia are crushed.

3. The parallel interwoven hyphae of the *Stilbella* which at the apex function as conidiophores are branched sometimes unlike the species character, the number of branches being up to 3.

Cultural studies at 25°C . show that growth on oat meal, corn meal and potato agar is similar to that of the fungus on Czapek-Dox-Yeast agar; no growth on Czapek, while on malt there is growth of mycelium but no production of cleistothecia or coremia. At 10°C . growth rate retarded and as a result cleistothecia and coremia formation took place after 3 weeks.

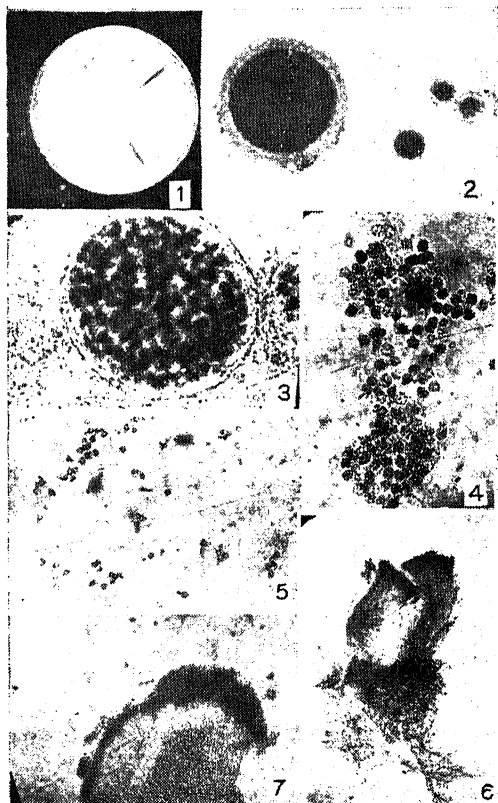


FIG. 1. *Emericellopsis symmematicola* var. *magnus*. 1. Growth of the fungus on corn meal agar after 3 weeks. 2. Cleistothecia of variable size. 3. Cleistothecia with asci. 4. Asci. 5. Ascospores. 6. Coremia. 7. Coremium top view showing conidial head and conidia.

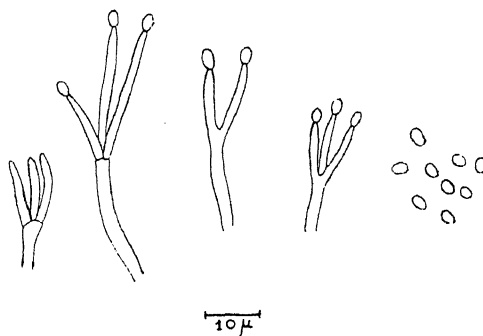


FIG. 2. *Emericellopsis symmematicola* var. *magnus*. Branched conidiophores bearing conidia at the tip.

Sincere thanks are due to Dr. R. Y. Roy for guidance in the course of study, to Prof. R. Misra for laboratory facilities, to Dr. H. Santapau for Latin diagnosis and to the Government of India for the Research Training Scholarship.

Department of Botany, K. M. LEELAVATHY.
Banaras Hindu University,
Varanasi, March 31, 1966.

1. Mathur and Tirumalachar, *Mycologia*, 1960, 52, 694.

COLCHICINE-GIBBERELLIN INTERACTION IN THE CONTROL OF ELONGATION OF *CUCUMIS* HYPOCOTYL

THE influence of antimitotic agent, colchicine on the growth of pattern of roots, has been investigated¹ but its effect on the other parts of intact seedlings has not received any attention so far. Since the application of colchicine results in a suppression of longitudinal growth of roots, it would be of interest to find out if it also causes a retardation of hypocotyl elongation. If elongation growth of hypocotyl were to be inhibited under the influence of colchicine, it should be possible to reverse such a growth-retarding effect by the application of gibberellin, as the latter is known to promote elongation not only through extension but also by affecting cell division in the sub-apical meristem.² Therefore, the present investigation is concerned with the study of the effect of colchicine on the rate of elongation as well as changes in fresh weight and dry weight of hypocotyl and to find out the interaction, if any, of colchicine and gibberellic acid in controlling the pattern of growth of intact hypocotyls.

Cucumis melo, L. seeds were germinated in 6" petri dishes on moistened filter-papers and

TABLE I

Growth changes in terms of length, fresh weight and dry weight of hypocotyl of *Cucumis* as influenced by exogenous supply of colchicine and gibberellic acid

(The results represent mean of three experiments)

Treatment	Length (cm.) of hypocotyl Days after treatment			Fresh weight (mg.)/hypocotyl Days after treatment			Dry weight (mg.)/hypocotyl Days after treatment		
	2	4	6	2	4	6	2	4	6
Control	5.10±0.3	7.40±0.6	11.40±0.3	21.3±0.7	113.3±3.0	168.8±4.0	1.40±0.1	3.80±0.2	4.80±0.2
Colchicine	1.90±0.2	2.40±0.2	2.60±0.3	14.0±0.2	51.0±4.0	68.0±3.0	1.00±0.03	2.40±0.1	2.60±0.2
Gibberellic acid	5.20±0.4	7.90±0.4	11.30±0.4	24.0±1.6	112.0±5.0	165.7±4.0	1.50±0.05	3.60±0.2	4.80±0.2
Colchicine + Gibberellic acid	4.70±0.3	6.30±0.3	9.50±0.5	18.4±1.0	108.0±4.0	170.0±5.0	1.30±0.05	3.75±0.2	4.70±0.25

were allowed to grow for 48 hours in darkness. Batches of 60 relatively uniform seedlings were then transferred to beakers containing 30 ml. of the following: (1) Distilled water; (2) 0.5% colchicine; (3) 0.005% gibberellic acid; (4) mixture of 0.05% colchicine and 0.005% gibberellic acid. After incubation for 3 hours in darkness in the above solutions, the seedcoats were removed, seedlings were rinsed thrice in distilled water and were placed in batches of 20 in each of the petri dishes on filter-papers previously saturated with distilled water. The seedlings were watered thereafter at regular intervals. The growth of seedlings in darkness was allowed for six days after treatment.

The seedlings were removed at 2-day intervals for the determination of the changes in length, fresh weight and dry weight of the hypocotyl. The experiment was repeated three times and the results are shown in Table I.

Colchicine application had resulted in a striking inhibition of hypocotyl elongation. The length of hypocotyl in colchicine-treated seedlings is almost only one quarter of that of controls at 6 days. While during the 6 days of growth the control hypocotyl had more than doubled itself in length the colchicine-treated samples failed to grow appreciably. Gibberellin treatment did not cause any marked promotion of elongation of controls, which is quite in line with its action since gibberellin enhances extension growth only in light. On the other hand, gibberellin when supplied together with colchicine had very nearly reversed the colchicine effect on hypocotyl elongation. Thus, a strong interaction was observed between colchicine and gibberellic acid in controlling the length of hypocotyl, i.e., gibberellin counteracting the effect of colchicine. Same trend was

observed as regards the growth changes in terms of fresh weight and dry weight of hypocotyls.

It appears, therefore, from the present study that colchicine and gibberellin have a common site of action, the former possessing an inhibitory and the latter having a promoting effect.

Department of Botany,

V. S. R. DAS.

S.V. University, Tirupati (A.P.), J. V. S. RAO.

February 24, 1966.

K. V. M. RAO.

1. Davidson, D., MacLeod, R. D. and Taylor, J., *New Phytol.*, 1965, **64**, 393.
2. Sachs, R. M., *Ann. Rev. Plant Physiol.*, 1965, **16**, 73.

GERMINATION OF SCLEROTIA OF SUGARCANE ERGOT

ERGOT on sugarcane (*Saccharum officinarum* Linn.) is a problem in sugarcane breeding. It was first recorded by Ocfemia (1931)¹ in Philippines and by Thirumalachar (1943)² in Mysore. Its occurrence on many varieties of seedling canes in Mysore was reported by Venkatarayan (1943).³ In infected canes, the sphacelial stage appears first, followed by the development of sclerotia.

Sclerotia from infected canes were collected from Hebbal, Bangalore, in January to study their germination under different conditions of media, temperature, relative humidity and light, the results of which are presented in Table I.

It is seen from Table I that the sugarcane ergot sclerotia can germinate in 21-80 days both in light as well as in darkness in moist sand. High temperature of 35-40° C. and darkness appear to be favourable for germination.

The sclerotia on germination produced stalked stroma (Fig. 1). The number of stromata

TABLE I
Germination of sugarcane ergot sclerotia under
different conditions

Sl. No.	Condition provided for germination	Germination %	Incubation period (days)	Remarks
1	Buried in moist sand and kept at room temperature exposed to light	20	23	
2	do. (sterilized condition)	15	80	
3	Buried in moist sand at room temperature in dark	80	60	Stalks very long 1-2"
4	do. (sterilized condition)	10 33	35 60	do. do.
5	Buried in moist sand and kept at 4-10° C.	..	..
6	do. (sterilized condition)	..	..
7	Buried in moist sand and kept at 35-45° C.	..	..
8	do. (sterilized condition)	50	12	
9	Buried in moist sand and kept at 35-40° C. during daytime and 4-10° C. during night time	..	..
10	do. (sterilized condition)	..	..
11	Placed on moist filter-paper over moist sand and kept at room temperature exposed to light	33	22	
12	do.	10	54	
13	Placed on moist filter-paper over moist sand and kept at room temperature in dark	10	21	
14	Placed in moist cotton and kept at room temperature	..	..
15	Floated on sterile water	..	..

varied from 1 to 5 in each sclerotium. The stalk was delicate, turgid, straw-yellow to white, straight to curved, 2-50 mm. in length. At the tip of the stalk the stroma was borne which was single or bilobed (0.9×0.6 mm.). It was pinkish and fleshy in colour and globular with flask-shaped osteolate perithecia ($157-257 \mu \times$

$93-128 \mu$) which were seen clearly in the spheridium crushed under a coverslip. Asci within the perithecia were long and tubular ($67-113 \mu \times 3.5 \mu$) with filiform ascospores ($51-102 \mu \times 0.6 \mu$).

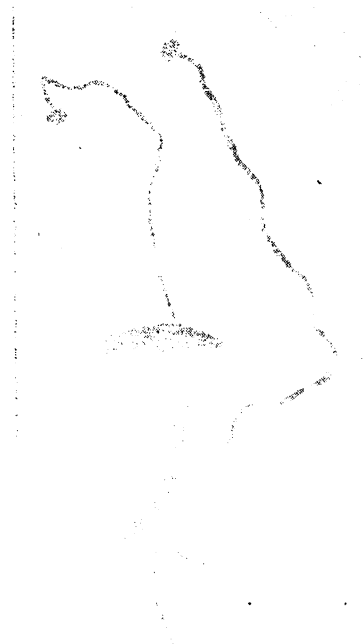


Fig. 1

FIG. 1. Germinated sugarcane ergot sclerotia, $\times 4$.

These measurements compare with those of *Claviceps purpurea* and agree with the findings of Ocfemia (1931).¹

I am grateful to Dr. H. C. Govindu for his help and encouragement.

Div. of Plant Path., V. RAJENDRAN.
Agri. College and Res. Inst.,
Bangalore-24, September 23, 1965.

1. Ocfemia, G. O., *Philippine Agriculturist*, 1931, **19**, 581.
2. Thirumalachar, M. J., *Curr. Sci.*, 1943, **12**, 330.
3. Venkatarayan, S. V., *The Mysore Agricultural Journal*, 1943, **22** (3), 75.

REVIEWS AND NOTICES OF BOOKS

Crystal Symmetry and Physical Properties.
By S. H. Friedberg. (McGraw-Hill Publishing
Company, New York, 1966. Pp. 300. Price
\$10.00.)

The author of this monograph is well known for quite some years now as the exponent of the group-theoretical method for the solution of problems in crystal physics, particularly those involving the effect of symmetry on the physical properties of single crystals. For results obtained have been published from time to time in different journals. The object of this book is to give a connected account of these results in respect of widely varying physical properties and with an introduction to the method employed.

The titles of the chapters contained in this book are listed as follows: 1. Linear Transformations; 2. Tensors; 3. Matrices; 4. Groups; 5. Crystallographic Groups; 6. Symmetry and Physical Properties; 7. Group Theoretical Method; 8. Classification of Physical Properties; 9. Strain; 10. Stress; 11. Elasticity; 12. Large Stresses and Strains; 13. Thermal Expansion; 14. Electrical Properties; 15. Magnetic Properties; 16. Optical Properties; 17. Transport Phenomena; and 18. Single Crystal Illustrations.

This book will be found to be of interest by students of solid state physics. Further, it will prove useful to the experimenter interested in studying the properties of single crystals.

C. V. R.

Fundamentals of Molecular Spectroscopy. By C. N. Banwell. (McGraw-Hill Publishing Company Limited, London), 1966. Pp. v + 291. Price 64c.

Spectroscopic methods are used increasingly for chemical analysis and for finding the shapes, sizes, and structures of many molecules. In the past these methods have only been taught empirically, but this book reflects the modern approach by also teaching an understanding of the methods. In providing an elementary introduction to all forms of electro-magnetic spectroscopy, the author covers radio-frequency, microwave, infra-red, Raman, ultra-violet and visible methods. The approach is, as far as possible, non-mathematical and does not require a knowledge of quantum mechanics. Emphasis

is laid on the physical basis and possible uses of the methods rather than on practical aspects. The book, which is comprehensive, contains several chapters on spectroscopic techniques and will be of particular use to undergraduate or early postgraduate students, as well as to all scientists interested in spectroscopic techniques for analysis.

C. V. R.

Advances in Electronics and Electron Physics
(Vol. 11). Edited by L. Marton. (Academic Press, New York and London), 1965. Pp. x + 16. Price \$14.00.

This volume contains the following articles: 1. The Polarization of Electron Beams and the Measurement of the g -Factor Anomaly of Free Electrons, by P. S. Farago; 2. Fast Ion Scattering against Metal Surfaces, by C. Snock and J. Kistemaker; 3. Kinetic Ejection of Electrons from Solids, by David B. Medved and Y. E. Chikaraev; 4. Scanning Electron Microscopy, by C. W. Oatley, W. C. Nixon, and R. F. W. Pease; 5. High Speed Magnetic-Core Memory Technology, by L. A. Russell; 6. Physical Foundations of Plasma Applications for Generation and Amplification of Microwaves, by V. Ya. Kislov, E. V. Bogdanov, and Z. S. Chernov. C. V. R.

Silicate Science (Vol. III). Dry Silicate Systems.
By Wilhelm Eitel. (Academic Press, New York and London), 1966. Pp. xiv + 553. Price \$22.00.

This volume of a five volume treatise is divided into two sections. It presents a comprehensive review of the literature dealing with progress made in silicate fusion equilibria and "dry" systems in the decade between 1953 and 1963.

Section A, *Dry Silicate Melt Equilibria, Crystallization, and Polymorphism*, contains discussions on modern advanced methods of experimentation for determination of fusion, crystallization, and polymorphic equilibria in the application of W. Gibbs's fundamental theory of heterogeneous phase equilibria. The tremendous progress in the practical and important theory of nucleation and growth of crystals from undercooled melts—a basis of modern "ceramoplasts" and "Pyroceram" bodies—and geochemical and geophysical problems like

those of the so-called "mantle" minerals in deep sites of the Earth's crust are also considered.

Section B, *Special Silicate Systems*, presents a systematic description of numerical results obtained in the study of special silicate systems. The system SiO_2 is thoroughly re-examined and evaluated. This volume gives wider aspects of the systematic enumeration of binary, ternary, quarternary, and polynary silicate systems, due to the inclusion of the effects caused by water in silicate systems as an important mineralizing aid in silicate synthesis. FeO and Fe_2O_3 containing silicate systems are also discussed with regard to the role of oxygen partial pressure effects. Silicate systems with complex anions formed in boro- and phosphatosilicates are presented in appendix.

C. V. R.

Biochemistry of Quinones. Edited by R. A. Morton. [Academic Press (London) Ltd., Berkeley Square House, London W. 1], 1965. Pp. 585. Price 117 sh. 6 d.

Quinones have long been noted for their great potential function as redox systems, but only recently has their widespread distribution in biological systems been recognized. Knowledge of the biochemistry of quinones ranks high in importance in biological investigations. Hence this multi-author treatise on the biochemistry of quinones will be fulfilling a need keenly felt at present.

Nineteen authors have contributed to the fifteen chapters in the book. Editor Morton has contributed the first two chapters giving an introductory account of quinones, and their ultra-violet absorption spectra. J. F. Pennock discusses the infra-red absorption spectra and NMR spectra of quinones, and jointly with F. W. Hemming has reviewed the subject of vitamins and ubiquinone status in animals. There is a chapter on the distribution of ubiquinones by F. L. Crane who, with D. I. Arnon, has contributed another chapter on the role of quinones in photosynthetic reactions. J. Green and D. McHale discuss quinones related to vitamin E. The chemistry of Isoprenoid quinones is reviewed by A. Langemann and O. Isler. The role of coenzyme Q in electron transfer is discussed by D. E. Green and G. B. Brierley.

Nutritional aspects with special reference to hypoprothrombinemia and vitamin K are discussed by E. A. Doisy, Jr. and John T. Matschiner. The chapter on "Chemistry and Function of Plastoquinone" is by E. R. Redfearn, while that on "The Role of Naphtho-

quinones in Oxidative Metabolism" is by Arnold F. Brodie. In the chapter on "Radiosensitization of Cells", J. S. Mitchell and D. H. Marrian survey the investigations carried out by their group on synkavit and menadione. There is a chapter on "Steady State and Kinetic Responses of Ubiquinone in Phosphorylating Mitochondria", in which B. Chance reviews the experimental work on the function of UQ in electron transport or oxidative phosphorylation processes in intact mitochondria.

From the above brief list of titles and authors it will be noticed that each contributor has written on the subject in which he has been most active, and thus the volume is an authoritative, up-to-date survey on the subject, and will remain as a guide-book for investigators in biochemical and biological researches.

A. S. G.

Handbook of Mathematical Functions with Formulas, Graphs and Mathematical Tables. Edited by Milton Abramowitz and Irene A. Stegun. (Dover Publications, 180, Varick Street, New York 14, N.Y.), 1965. Pp. xiv + 1043. Price \$ 4.

In spite of the increasing availability and use of computing machines there exists the demand by scientists and engineers for numerical tables of mathematical functions. The National Bureau of Standards, U.S.A., has long been bringing out mathematical tables, and the need for a compendium like the present one (a modernized version of Jahnke-Emde classical tables of functions) was emphasized at a Conference on Tables held in 1954. The NBS undertook the task under the sponsorship of the National Science Foundation, and the outcome was the original of the present *Handbook* published in 1964.

This Giant Dover Paperback under review is an unabridged and unaltered republication of the above work, and is now made available at low price for wider possession by individual users.

The book contains 29 sets of tables. These include tables of mathematical and physical constants and conversion factors; elementary transcendental functions; tables for exponential integral and related functions; Fresnel integrals, Legendre functions, Bessel functions and Struve functions; Jacobian elliptic and theta functions; Mathieu functions; Orthogonal polynomials; Probability functions; Laplace-transforms, etc.

A. S. G.

Osmotic Regulation in Aquatic Animals. By August Krogh. (Dover Publications, 180, Varick Street, New York-14, N.Y.), Pp. 242. Price \$ 1.75.

Great progress has taken place in recent years in the study and understanding of animal osmosis. Still the book by Professor Krogh on *Osmotic Regulation in Aquatic Animals*, originally published by the Cambridge University Press in 1939, continues to be a classic on the subject.

Although normally permeable to water, aquatic animals are able to maintain a different concentration of their body fluids from that of the surrounding water, establishing a steady state condition between the internal and external media. This condition which involves an ionic steady state along with osmotic equilibrium can be achieved only by the steady expenditure of energy in special mechanisms adapted for the purpose in each group of aquatic animals. The book, in the main, describes the osmotic and ionic steady states, locates the mechanisms by which they are maintained, and explains their mode of action. Each chapter in the book, of which there are fourteen, deals with a major systematic group, such as Protozoa, Coelenterata, Echinoderma, Scolecida, Annelida, Mollusca, Crustacea, Elasmobranchii, Amphibia, etc., etc.

A. S. G.

Dover Publications :

1. Superfluids. By the Late Fritz London. (Vol. II: *Macroscopic Theory of Superfluid Helium*), 1964. Pp. xiv + 217. Price \$ 1.75.

This book is an unabridged and unaltered republication of the work first published in 1954, in which the author discussed liquid helium II, a peculiar substance, which has been called a "fourth state" of matter, the quantum effects of its properties as they are manifest on a macroscopic scale providing an interpretation of its more relevant properties, particularly superfluidity. The author covers such topics as energy and structure of condensed helium at absolute zero; the evolution of the two-fluid concept; the hydrodynamic quasi-continuum; two-fluid thermohydrodynamics, and the helium isotope He^3 .

The book is of more than historic interest and should be of value to all physicists, especially those working on low-temperature physics.

2. *Statistical Adjustment Data.* By W. Edwards Deming, 1964. Pp. x + 261. Price \$ 1.75.

This book is a corrected unabridged reprint of the first edition published in 1943. The subject-matter in the volume is dealt with in five parts. The first section, covering simple adjustments and including a series of illustrations of curve fitting, is an introduction to basic statistical concepts and to the concept of "adjustments". The second section is devoted to solution by squares of more complicated problems and takes into account the propagation of error and the general problem of least squares, while the next two sections cover conditions with and without parameters. The final part of the book provides 26 exercises on fitting various functions. A final section contains 4 additional examples on curve fitting.

Students and teachers will find this book useful as a class-room text, while practising statisticians will find the inclusion of all this material within a single volume very convenient.

V. S. R.

Books Received

Chemistry and Physics of Carbon (Vol. I). Edited by P. L. Walker Jr. (Marcel Dekker, Inc., 95, Madison Avenue, New York, N.Y.), 1966. Pp. xv + 382. Price \$ 13.75.

Annual Review of Pharmacology (Vol. 6). (Annual Reviews, Inc., 231, Grant Avenue, Palo Alto, California), 1966. Pp. vii + 496. Price \$ 9.00.

Laboratory Physics (Parts C & D). Berkeley Physics Laboratory. (McGraw-Hill Book Co., New York), 1966. Pp. viii + 119.

Handbuch Der Kolorimetrie (Band III. *Kolorimetrie in Der Biologie, Biochemie und Medizin*). By B. Kakac and Z. J. Vejdeck. (Veb Gustav Fischer Verlag Jena, 69 Jena, Villengang 2), 1966. Pp. xiii + 857. Price 76 MDN.

German for Science Students—The Essential Grammar with Graded Scientific Texts. By A. H. Rosenberg Rodgers and E. K. Horwood. (Ifsee Books Ltd., Dorset House, Stamford St., London SE 1), 1966. Pp. xv + 202. Price 30 sh.

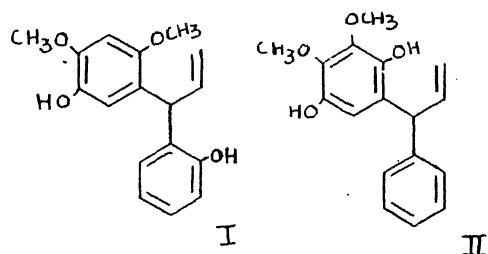
Essays on Mathematics Education. By J. N. Kapur. (Ramchand and Co., Ansari Road, Doryaganj, Delhi-6), 1966. Pp. 170. Price Rs. 10.

4-PHENYL COUMARINS AS PRECURSORS OF NEOFLAVANOIDS

D. KUMARI, S. K. MUKERJEE, T. SAROJA AND T. R. SESHADRI

Department of Chemistry, Delhi University, Delhi-7

THE neoflavanoids¹ are a recent group of naturally occurring C₁₅-phenolic compounds comprising of 4-phenyl coumarins, 3, 3-diphenyl allyl compounds and allyl quinones (dalbergenones). Although a number of 4-phenyl coumarins and dalbergenones are known, so far only two examples of allyl phenols have been found in nature. These are (a) latifolin (I) and (b) the quinol (II).



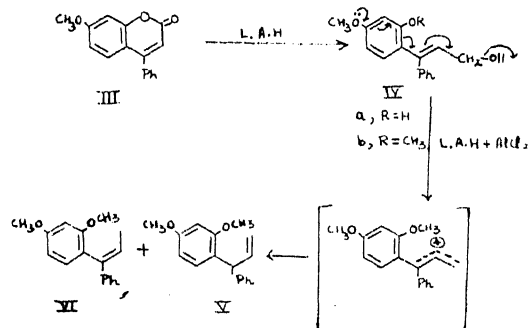
Eyton *et al.*² consider these phenolic allyl compounds as precursors for the whole group; they themselves are formed by an alkylation process involving cinnamyl pyrophosphate (C₉) and a phenolic (C₁₁) unit. The allyl phenols then undergo oxidation to dalbergenones and further cyclisation and oxidation lead to 4-phenyl coumarins. They considered³ Claisen migration as a laboratory analogy for this coupling process; the unsuitability of this analogy has already been pointed out.⁴ Moreover for phenolic precursors of dalbergenones with methoxyl (or hydroxyl) groups in ring 'B', this alkylation process would not be facile.

In an earlier publication⁴ from this laboratory an alternative pathway to the neoflavanoids was suggested in which 4-phenyl coumarins were postulated as precursors of the whole group. According to this scheme the 4-phenyl coumarins undergo reduction to the corresponding cinnamyl alcohols and these, having the oxygen functions both at ortho and para positions in ring (A), are in a favourable position to undergo reduction in the side chain leading to latifolin type of skeleton. Subsequent oxidation gives rise to dalbergenones. This is more in accordance with the idea of Birch⁵ regarding the origin of natural allyl phenols from cinnamyl alcohols.

In this preliminary publication we wish to report laboratory experiments in support of the above idea. 7-Methoxy-4-phenyl coumarin⁶ (III) was reduced by the inverse-addition of lithium aluminium hydride in dry ether to 3-

(2-hydroxy-4-methoxyphenyl)-3-phenyl allyl alcohol (IV a). It crystallised from hot benzene as colourless prisms, m.p. 140–41° (Found: C, 74.3; H, 5.9. C₁₆H₁₆O₃ requires C, 74.7; H, 6.2%). $\lambda_{\text{max}}^{\text{MeOH}}$ 240 m μ with inflexion at 285 m μ . Catalytic hydrogenation gave the corresponding propyl alcohol as an oil, $\lambda_{\text{max}}^{\text{MeOH}}$ 280 m μ . Methylation of (IV a) by methyl iodide, acetone-potassium carbonate method followed by purification on silica gel gave the methyl ether (IV b). It was obtained as colourless plates from methanol, m.p. 68–70° (Found: C, 75.1; H, 6.8. C₁₇H₁₈O₃ requires C, 75.5; H, 6.7%). $\lambda_{\text{max}}^{\text{MeOH}}$ 240 and 280 m μ . A small amount of (IV b) gave on oxidation with Lemieux reagent⁷ 2,4-dimethoxy benzophenone identical with an authentic compound.

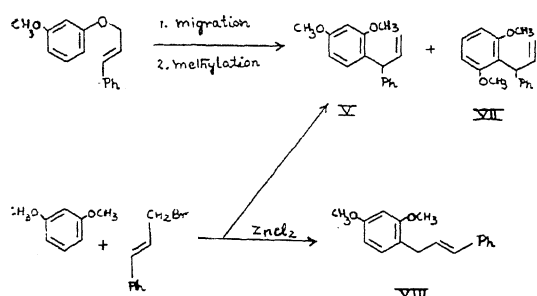
The methoxy cinnamyl alcohol (IV b) when stirred at room temperature for one hour with previously prepared mixture of aluminium chloride and lithium aluminium hydride, produced a (1:1) mixture of 3- (2:4-dimethoxy phenyl)-3-phenyl propene (V) and the corresponding 1:1-disubstituted isomer (VI). Comparison with authentic allyl (V) and propenyl (VI) compounds established their



identity and the composition of the mixture was determined approximately by visual estimation of colour in spots produced on T.L.C. plates. Variation of the ratio of aluminium chloride to the hydride (1 to 3 moles of AlCl₃ per mole of LAH) and variation of reaction temperature did not appreciably alter the composition of the mixture. Fused zinc chloride can substitute aluminium chloride in this reaction. The cationic intermediate produced with this reagent is stable as shown in one experiment in which the cinnamyl alcohol (IV b) was treated first with zinc chloride and the hydride was added subsequently to the mixture;

the composition of the product was essentially the same as when previously mixed reagents were employed. However, the use of zinc chloride leads to the formation of more of isomer (VI) (70%).

Authentic diphenyl allyl compound (V) was prepared by methylation of 3-(2-hydroxy-4-methoxyphenyl)-3-phenyl propene.³ It was also



obtained by coupling resorcinol dimethyl ether with cinnamyl bromide in the presence of zinc chloride. This reaction gave a complicated mixture of eight compounds; out of these two major and closely moving compounds were separated. They consisted of the allyl compound (V) and the isomeric benzyl styrene (VIII) and were used to identify the product obtained by the Claisen migration route which was contaminated with 3-(2, 6-dimethoxy-

phenyl)-3-phenyl propene (VII). The allyl compound (V) was a liquid; $\lambda_{\text{max}}^{\text{MeOH}}$ 285 μ (Found: C, 80.5; H, 7.6. C₁₇H₁₈O₂ requires C, 80.0; H, 7.1%).

Authentic propenyl isomer (VI) was prepared by Grignard reaction of 2, 4-dimethoxy benzophenone with ethyl magnesium bromide and dehydrating the product. It crystallised from methanol as colourless plates, m.p. 73–74° (Found: C, 79.5; H, 7.6. C₁₇H₁₈O₂ requires C, 80.0; H, 7.1%). $\lambda_{\text{max}}^{\text{MeOH}}$ 240 m μ with inflexion at 285 m μ .

Fuller scope of this reaction is under investigation.

1. Eyton, W. B., Ollis, W. D., Sutherland, I. O., Gottlieb, O. R., Magalhaes, M. T. and Jackman, L. M., *Tetrahedron*, 1965, **21**, 2683.
2. —, —, Finberg, M., Gottlieb, O. R., Salignac de Souza Guimaraes, I. and Magalhaes, M. T., *Ibid.*, 1965, **21**, 2697.
3. Barnes, M. T., Ollis, W. D., Sutherland, I. O., Gottlieb, O. R. and Magalhaes, M. T., *Ibid.*, 1965, **21**, 2707.
4. Kumari, D., Mukerjee, S. K. and Seshadri, T. K., *Ibid.* (In press).
5. Birch, A. J., *Biosynthetic Pathways in Chemical Plant Taxonomy*, (Edited by T. Swain), Academic Press, 1963, p. 141.
6. Robinson, R. and Turner, M. R., *Chem. Soc. Journal*, 1918, **113**, 875.
7. Lemieux, R. U. and Rudloff, E. von., *Canadian J. Chem.*, 1955, **33**, 1710.

THIN LAYER CHROMATOGRAPHY OF INORGANIC IONS

Part I. Separation of Zinc, Copper, Cadmium, Cobalt and Nickel as their Thiocyanate Complexes

M. R. VERMA AND JITENDRA RAI

National Physical Laboratory, New Delhi-12

THE technique of Thin Layer Chromatography (T.L.C.), on account of its speed and elegance, has been extensively employed for organic separations. Seiler¹ *et al.*, in a series of papers, have attempted to apply this technique to inorganic ions but on repeating some of these experiments, no compact spots were obtained. Hranisavljevic—Jakovljevic² *et al.* also described separation of metals as their dithizonates. Apart from this no extended use appears to have been made of this technique for the separation of inorganic ions.

Following the suggestions of Pollard and McComie³ that the solubility of metallic thiocyanate in organic solvents should merit their examinations in chromatography, paper chromatographic methods were developed in this laboratory, for the separation from their mixture of (1) copper, cobalt and nickel⁴ and

(2) cadmium and zinc.⁵ It was considered desirable to extend these investigations to explore the possibility of the separation of all the above five ions from their mixture by using T.L.C.

It is well known that of the five above mentioned ions, Cobalt and Zinc thiocyanates are fairly soluble in organic solvents. However, on addition of Pyridine, all the five of the metal ions form complexes of the type $M \text{Py}_n (\text{SCN})_m$,⁶ which are extractable with organic solvents. The combination of solvents, and (i) Thiocyanate or (ii) Pyridine and thiocyanate in the same solution, however, gives an eluent which effectively buffers the chromatogram and thus become more effective for the chromatographic separations.

In the present investigation several eluents based on thiocyanate with or without pyridine

were tried for studying the chromatographic behaviour of the aforementioned ions on a thin layer of Silica Gel 'G' (E merck), coated on a glass plate. The ions in turn were detected by spraying with suitable reagents.

EXPERIMENTAL

Following solutions were prepared :

1. Solution of Metal Ions

Separate solutions of Zn, Cu, Cd, Co and Ni of M/100 strength.

2. Fluents

A. Ammonium thiocyanate 4 gm.; Alcohol (methyl or ethyl or *n*-butyl or iso-propyl or iso-amyl) 80 ml.; Base (liquid Ammonia 0.910 or Sodium hydroxide 10% or Tetramethyl ammonium hydroxide 10% solution) 10 ml.

B. Ammonium thiocyanate 4 gm.; Ethanol 60 ml.; Methyl ethyl ketone 40 ml.; Tetramethyl ammonium hydroxide 10 ml.

C. Ammonium thiocyanate 4 gm.; Alcohol (methyl or ethyl or *n*-butyl or iso-propyl or iso-amyl) 80 ml.; Base (liquid Ammonia 0.910 or Sodium hydroxide 10% or Tetramethyl ammonium hydroxide 10% solution) 10 ml.; Pyridine 10 ml.

D. Ammonium thiocyanate 4 gm.; Ethanol 60 ml.; Benzene 35 ml.; Tetramethyl ammonium hydroxide 10 ml.; α -Picoline 10 ml.

3. Detection

1% solution of Rubeanic acid in alcohol was sprayed on the developed chromatogram to locate the spots of copper, cobalt, nickel which respectively gave slate-grey, orange and violet coloured spots.

This was followed by spraying with 0.5% solution in alcohol of 8-hydroxyquinoline. On exposure to ultra-violet light Zn and Cd spots gave yellow fluorescence.

A slurry of Silica Gel 'G' (E merck) was made and applied in the form of a thin layer on a glass plate with the help of an applicator. The plates were dried at 110°C. for 2 hours and stored in a desiccator. One drop each of solutions of the salt was applied separately on the base line, the same kept in a battery jar and the chromatogram run in the usual manner, the concentration of the constituents of the eluents which gave compact and well separated spots of respective metal ions was worked out. These described under (2) above gave the best results.

In addition to the nature of eluents, the extent of migration of the ions was also

affected by the ambient temperature. At lower temperatures (about 10°C.), although the movement was slow, well separated spots were obtained.

Some of the special features of the present investigations are as under :

- (i) All the eluents used are alkaline. In the initial stages ammonia was used, but on account of its volatility, reproducible results were not obtained. Best results were obtained by using tetramethyl ammonium hydroxide for adjusting the alkalinity.
- (ii) Compactness of the spots is improved by incorporating thiocyanate in the eluent itself.
- (iii) Use of higher alcohols led to the formation of more compact spots, but it took longer to develop the chromatogram.
- (iv) The position of some of the metal ions on the chromatogram was changed considerably by incorporating pyridine or α -picoline in the eluent. Especially, the position of cobalt and copper is reversed in the two sets of eluents, viz., those with or without pyridine.
- (v) Zinc shows practically no movement in any of the eluents except those in which a typical ketone like methyl ethyl ketone is incorporated, however, in the latter case, other ions do not show a very distinctive separation.

Unlike paper chromatography, no definite R_f values can be given. However, over a fairly wide range of temperature the order in which various ions are likely to be located remains the same. Thus it becomes possible to detect the presence of one or more of the above mentioned ions from a mixture.

In a typical case, spots of the mixture of the above ions were applied on a plate alongside with the various metal ions separately and chromatogram run. It was found that a period of 40-45 minutes was enough to separate various ions and these in turn could be detected by spraying with rubeanic acid and 8-hydroxyquinoline solution separately. Typical separations using two eluents are shown in Figs. 1 and 2.

Summary and Discussion of Results

The present investigation makes available a process that may be utilized for getting a clear separation between number of metal ions on thin layer chromatogram. The respective ions can be located by spraying the chromatogram with suitable reagents when characteristic coloured spots are obtained. The essential con-

stituents of the eluents used is alkaline thiocyanate with or without pyridine.

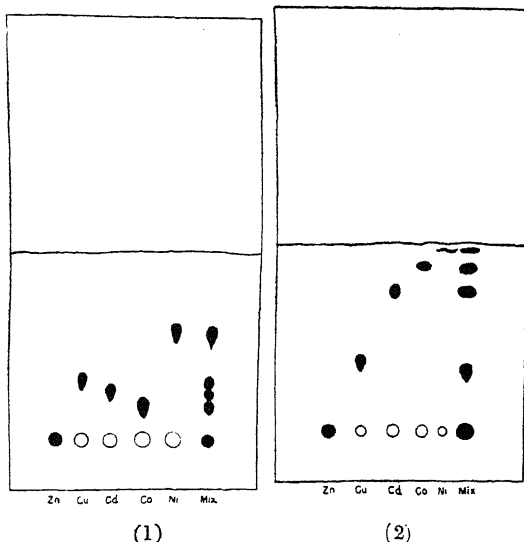


FIG. 1

Eluent: Ammonium thiocyanate 4 gm.
Methanol 80 ml.
Tetramethyl ammonium hydroxide (10%) 10 ml.

FIG. 2

Eluent: Ammonium thiocyanate 4 gm.
Iso-propyl alcohol 80 ml.
Tetramethyl ammonium hydroxide (10%) 10 ml.
Pyridine 10 ml.

The chromatographic separation of the metal ions treated is based on the formation of their thiocyanate complexes.

The procedure developed herewith is a one stage process and does not require a prior separation of the complexed metal ions by extraction. The medium, viz., silica gel does not have to be specifically freed of iron as the thiocyanate complex of the same is colourless in an alkaline medium.

1. Seiler, H., *et al.* *Helv. Chimica Acta*, 1960, **43**, 1939; 1961, **44**, 939; 1961, **44**, 941; 1962, **45**, 381.
2. Marini-Bettolo, G. B., *Thin Layer Chromatography*, Elsevier M. Hranisavljevic-Jakovljevic and I. Pejkoivic-Tadic, 1964, p. 222.
3. Pollard, F. H. and McComie, J. F. W., *Chromatographic Method of Inorganic Analysis*, Butterworths Scientific Publication, London, 1953, p. 60.
4. Verma, M. R. and Gupta, P. K., *Curr. Sci.*, 1961, **30**, 10.
5. — and —, *Ibid.*, 1962, **31**, 10.
6. Lock, L. C. and Martin, E. C., *J. Chromatography*, 1962, **7**, 120-27.

CARDIOVASCULAR RESPONSE TO THE ADRENERGIC AND CHOLINERGIC DRUGS IN EMBRYONIC AND LARVAL STAGES OF *GAMBUSIA AFFINIS* PATRUELIS, BAIRD AND GIRARD

A. K. DORIE AND D. K. BELSARE

University Department of Pharmacy and Post-Graduate Department of Zoology,
Nagpur University, Nagpur

ALTHOUGH it is generally accepted that fishes possess a sympathetic nervous system, there is no unequivocal evidence that the system has an effect on the piscine heart and circulation.¹ The existence of the cardio-accelerator sympathetic fibres has been reported by Mott,² but Lutz³ and Burger and Bradley⁴ have failed to find any evidence for this. Further, it is believed that there are two receptor sites, the α and β , available to the adrenergic drugs in the receptor cells. There is no evidence so far, as to which of the adrenergic receptors mediate in the action of adrenergic drugs on the piscine heart. It is for this reason that the present work was undertaken to throw some light on the problem. The embryonic and larval stages of the viviparous fish, *Gambusia affinis* were specially selected because of the considerable variation in the heart rate of this fish at different stages of the development suggesting a variation in the autonomous cardiac control in them.

The embryos of *G. affinis patruelis* were obtained from gravid females by dissecting out the uterus and removing the egg membrane. The larvae treated were about 30 hours of age and measured 6-7 mm. in length. To study myocardial activity, the embryo or larva was placed on wet cotton in the prone position under the dissecting microscope. The normal cardiac rate was first noted by counting the heart-beats per 10 seconds. Two drops of drug were then added to the surrounding medium in varying concentrations ranging from 0.01 μ g. to 1 μ g./c.c., observing constantly the rate of myocardial contraction. At least 10 readings for each response were taken.

The normal heart rate of the embryo is higher (132) than that of larva (72) per minute at 26°C., and it is in agreement with the report of Grodzinski^{6,7} on the piscine heart.

Adrenaline first increased and then decreased the cardiac rate of the embryo. In the larva, however, the increase was not followed by

TABLE I

The results are summarised in Table I.

	Embryo Cardiac rate/min.		Larva Cardiac rate/min.	
	Initial	Successive	Initial	Successive
Normal	.. 102	..	72	..
Adrenaline	.. 180	60	146	74
Noradrenaline	.. Inhibition	304	96	..
Isoprenaline	.. 130	..	98	..
Acetylcholine	.. 36	..	28	..
Atropine	.. 130	85	90	..
Dihydroergot	.. 116	..	88	..
Inderol	.. 120	..	78	..
Dihydroergot + Adrenaline	.. 116	72	84	70
Dihydroergot + Noradrenaline	Inhibition	108	90	..
Dihydroergot + Isoprenaline	.. 120	..	82	..
Inderol + Adrenaline	.. 132	72	116	..
Inderol + Noradrenaline	Inhibition	270	118	..
Inderol + Isoprenaline	.. 104	..	70	..
Atropine + Acetylcholine	.. 78	..	82	..
Atropine + Adrenaline	.. 172	106	140	..
Atropine + Noradrenaline	.. 202*	116	88	..
Atropine + Isoprenaline	.. 118	..	86	..

* No initial inhibition.

depression. Noradrenaline caused immediate and transient inhibition in the embryo followed by powerful acceleration of cardiac rate. The initial inhibition lasted about five seconds and the acceleration about five minutes. The larval heart was only slightly stimulated by noradrenaline. Isoprenaline accelerated and acetylcholine inhibited the cardiac activity in both the embryo and the larva.

Dihydroergot (Hydergine, Ciba), inderol and atropine slightly accelerated the rate of embryonic heart. In the larva, inderol had no significant effect, whereas dihydroergot and atropine caused slight stimulation.

The prior administration of dihydroergot reduced the action of adrenaline, noradrenaline and isoprenaline in the embryo as well as in the larva. Inderol blocked the augmentary action of adrenaline in the embryo as well as in the larva, with no influence on the depressant phase of its action in the embryo. The augmentary action of noradrenaline was only slightly reduced, and that of isoprenaline was completely blocked by the prior administration of inderol in the embryo and also in the larva. The prior administration of atropine completely blocked the depressant phase of

actions of adrenaline and noradrenaline in the embryo. Atropine reduced the cardiac inhibition by acetylcholine to a considerable extent, but did not inhibit it completely in the embryo; whereas in the larva, it totally blocked it.

Ostlund⁸ observed that adrenaline first inhibits and then stimulates the piscine heart and that the inhibition is partially prevented by atropine. We find that while embryonic heart is first stimulated and then depressed, the larval heart is only stimulated by adrenaline in *G. affinis*. That the cardiac inhibition by adrenaline in the embryo, which follows the initial stimulation, is prevented by the prior administration of atropine is in agreement with Ostlund's⁸ observation. Dihydroergot, which blocks mainly the α and to some extent the β -adrenergic receptors,⁹ or inderol, which selectively blocks the β -adrenergic receptor,¹⁰ do not prevent this action. This leads to the inference that the inhibitory response of piscine heart to adrenaline is mediated through the parasympathetic nerves and not through any of the adrenergic receptors. The reflex vagal stimulation by adrenaline leading to the cardiac inhibition in higher vertebrates is well known.¹¹

The influence of noradrenaline on the embryonic and the larval heart presents certain interesting features. The embryonic heart is first inhibited and then powerfully accelerated, while the larval heart is only slightly stimulated. The initial depression of cardiac activity in the embryo is prevented by atropine suggesting that it is cholinergic in origin. The absence of initial inhibition in the cardiac activity after noradrenaline administration to the larva suggests that the vagal tone is more intense at the embryonic stage than at the larval one. The myocardial ectopic excitation has been shown to be the property of noradrenaline¹² and the fact that noradrenaline evokes the stronger chronotropic effect on the embryonic heart than on the larval one indicates that the former is under comparatively weaker sympathetic control. It is possible that the overall cardiac action of noradrenaline in embryo is resultant of two different mechanisms, first, the direct or reflex parasympathetic stimulation inducing cardiac inhibition and second, the direct myocardial stimulation strong enough to overcome the inhibition due to the former.

Isoprenaline induces only the cardiac acceleration in the larva as well as in the embryo. This shows that the β -adrenergic receptors of which the isoprenaline is the mediator,¹³ are not involved in the parasympathetic stimulation in either of the developmental stages of the fish. On the other hand the

myocardial stimulation is a common feature to the action of all the three adrenergic drugs, which indicates that both the α and β -adrenergic receptors are concerned in their augmentary action. This is further supported by the fact that both dihydroergot as well as inderol can block the augmentary action of the three adrenergic drugs.

In conclusion it appears that while isoprenaline is only stimulatory, adrenaline and noradrenaline exhibit a diphasic action on the piscine heart, inhibitory as well as augmentary. Of these, the inhibitory action is mediated through cholinergic nerve, more prominently during embryonic stage of development, presumably because the vagal tone is stronger at this stage. This action is mainly associated with the α and not with the β -adrenergic receptors. On the other hand the β -adrenergic receptors mainly mediate the augmentary action.

The authors are grateful to the I.C.I., London, for the supply of Inderol.

1. Mott, J. C., *Physiology of Fishes*, ed. M. E. Brown, New York Acad. Press, New York, 1957, 1.
2. —, *J. Physiol. (Lond.)*, 1951, **114**, 387.
3. Lutz, B. R., *Am. J. Physiol.*, 1930, **94**, 135.
4. Burger, J. W. and Bradley, S. E., *J. Cellular Comp. Physiol.*, 1951, **37**, 389.
5. Ahlquist, R. P., *Am. J. Physiol.*, 1945, **153**, 586.
6. Grodzinski, Z., *Bull. acad. Polon. Sci. Ser.*, 1950, **2B**, 173.
7. —, *Ibid.*, Classe II, 1954, **2**, 19.
8. Ostlund, E., *Acta Physiol. Scand.*, 1954, **31**, 112.
9. Levy, B., *J. Pharmacol. Exptl. Therap.*, 1959, **127**, 150.
10. Black, J. W., Crowther, A. F., Shanks, R. G., Smith, L. H. and Durnhorst, A. C., *Lancet*, 1964, **1**, 1080.
11. Darrow, C. W., *Physiol. Rev.*, 1943, **23**, 1.
12. Drill, V. A., *Pharmacology in Medicine*, McGraw-Hill Book Co., New York, 1954, pp. 26/3.
13. Krantz, J. C. Jr. and Carr, C. J., *Pharmacological Principles of Medical Practice*, Williams & Wilkins Co., Baltimore, 1965, p. 562.

RELATIVE RESPONSE OF THE RICE PLANT TO BLUE-GREEN ALGAE AND AMMONIUM SULPHATE IN BULK TRIALS

R. SUBRAHMANYAN* AND G. B. MANNA**

Central Rice Research Institute, Cuttack, Orissa

AN experiment to demonstrate the efficacy of blue-green algae in the nitrogen nutrition of the rice plant over the common fertilizer used in rice cultivation, viz., ammonium sulphate, was laid out during *dalua* (December-April) 1964-65 in the Central Rice Research Institute. Two identical plots of 10 × 10 metres were chosen. To plot (1) ammonium sulphate at 30 kg. N/ha was applied after transplantation; to the second, plot (2) a basal dressing of lime at 1000 kg./ha + superphosphate at 30 kg. P₂O₅/ha was given and after transplantation sodium molybdate at 280 grams/ha and a blue-green algal mixture consisting of *Anabaena* sp. and *Nostoc* sp. (both nitrogen fixers) at 2 gm. dry weight/ha was applied. Fresh algae from cultures of one of us (R.S.) were used.

Soon after application of ammonium sulphate, in the plot (1) concerned *Euglena* sp. and *Spirogyra* sp. (green forms of algae) developed considerably. In plot (2) no green forms developed, but *Anabaena*, grew dominating the blue-green forms therein. Usually, as is the practice, when dried blue-green algae are applied,

it takes about 4 to 5 weeks for them to develop; in the present instance, where fresh algae had been applied, their growth was evident soon.

Within a short period, about 4 weeks, a remarkable difference was noticed between the two plots; plot (2) showed more vigorous growth of the rice plants therein, the number of tillers in each hill being almost double the number compared with plot (1). This is attributable to the beneficial rôle of the blue-green algae which besides supplying the nitrogen requirements of the plants, perhaps supply some growth-promoting substances as well and, further, suppress the growth of green forms of algae as also weeds which consume the nutrition meant for the rice plant.^{1 12}

It is well known that blue-green algae liberate soluble substances of the nature of carbohydrates, polysaccharides, polypeptides, amino-acids, plant hormones such as auxin and also certain toxins.¹³ It would appear that the better growth of the rice plant in the plots with blue-green algae is due to the former category of substances and apparently the toxins do not affect the rice plant but exercise a deleterious effect on the green forms of algae and several weeds in the field as these are found to have a set back when the blue-green algae are conspicuously present. Further work

* Present address: Central Marine Fisheries Research Institute, Substation, Ernakulam-1, Kerala.

** Present address: Department of Agricultural Engineering, Indian Institute of Technology, Kharagpur, W. Bengal.

on this rôle of the blue-green algae would be rewarding.

However, after a short while, the leaves of the rice plants in both the plots began to turn yellow and into orange colour and it looked as though the crop was going to be a failure. This symptom appeared to us to be a "deficiency disease" owing to lack of some essential substances. Therefore, the water in the plots was drained out, and after a day, a very highly dilute solution of salts† containing Mo, Cu, Mn, Fe, Zn and B was sprayed over the soil surface in both the plots and water was let in. The crop showed signs of recovery and, therefore, the treatment was repeated once again as only very minute quantities of the elements had been given in the first instance. Thereafter, the crop picked up and thrived.

In one of our earlier accounts⁶ we had referred to the possibility of trace elements being limiting factors for growth of the rice plant; the above treatment lends support to the rôle of trace elements.

The particulars relating to the crop and yield data are presented in Table I.

It may be seen that the blue-green algae treatment has produced an increase of grain and straw yield of 24% and 23% respectively over the ammonium sulphate application. This is accounted for by the greater number of tillers, panicle length and grain weight (1000 grains). Therefore, the schedule of applying lime superphosphate, sodium molybdate and blue-green algae is definitely a better and superior substitute for ammonium sulphate. Further, as pointed out by us elsewhere¹⁰ the algal treatment promoted fertility build-up of the soil, leaving a favourable residual effect which supported two crops (may be it could be more) the yield being affected in no way; hence, it is an economical method as well.¹⁰

The other important point to be noted is the revival of the crop when trace elements were applied. The type of yellowing noticed is often met with in several parts of the country. This may also be due to depletion of the essential trace elements as a result of intensive continuous cultivation over centuries and attention being not paid to this aspect. Incidentally, it may be mentioned that such deficiencies might lower the resistance of the plants to diseases caused by various pathogens. Such a phenomenon is unusual in fields which had received green manure or other types of organic manures; obviously, these manures should be

† Solution of: FeCl_2 —10 gm.; MnSO_4 —3 gm.; H_3BO_3 —10 gm.; CuSO_4 —1 gm.; ZnSO_4 —5 gm.; and MoO_3 —10 gm. in 1000 litres per hectare.

TABLE I
Yield of grain, straw and biometrical data
Second Season (Dakua) 1964-65 (December-April)

	(1) Ammonium Sulphate @ 30 kg. N./ha.	(2) Lime 1000 kg./ha. + Superphosphate 30 kg. P_2O_5 /ha. + Sodium molybdate 0.28 kg./ha. + blue- green algae (<i>Nostoc</i> sp. and <i>Anabaena</i> sp.)
1. Height in cms. ..	114.2	120.7
2. Ear bearing tillers per 0.45 sq. m.	89 (100%)	103 (116%)
3. Panicle length in cm.	18.8	20.5
4. 1000 grain weight in gm.	21.7	22.3
5. Grain yield kg./ha. ..	2600 (100%)	3225 (124%)
6. Straw yield kg./ha. ..	3100 (100%)	3800 (123%)

Other particulars:

1. Variety TKM 6;
2. Date of sowing nursery: 12-12-64;
3. Plot size: 10 metres \times 10 metres = 100 sq. m.;
4. Date of transplanting: 23-1-65;
5. Spacing: 15 cm. \times 15 cm.;
6. Date of harvesting: 26-4-65.

containing the required trace elements. The repeated use of mineral synthetic fertilizers, on the other hand, do not meet the whole requirement of the rice plant and the response to these fertilizers will depend on the availability of the trace elements in the soil which would act as limiting factors. It may be of interest to mention here that crops showing such symptoms often recover when flood water or polluted water enter the fields; evidently, this water must be bringing in some or most of the deficient elements.

We thank Dr. R. H. Richharia, Director, Central Rice Research Institute, for his keen interest in our work.

1. Relwani, L. L., *Curr. Sci.*, 1963, **32**, 417.
2. —, *Ibid.*, 1965, **34**, 188.
3. — and Manna, G. B., *Ibid.*, 1964, **33**, 687.
4. — and Subrahmanyam, R., *Ibid.*, 1963, **32**, 441.
5. Sahay, M. N., *Proc. Ind. Acad. Sci.*, 1966, **63 B**, 223.
6. Subrahmanyam, R., Manna, G. B. and Patnaik, S., *Ibid.*, 1965, **62 B**, 171.
7. —, Relwani, L. L. and Manna, G. B., *Curr. Sci.*, 1964, **33**, 485.
8. —, — and —, *Proc. Ind. Acad. Sci.*, 1964, **60 B**, 293.
9. —, — and —, *Symp. Land Fertility, Natl. Acad. Sci., Allahabad*, Feb. 1964, (In press).
10. —, — and —, *Proc. Ind. Acad. Sci.*, 1965, **62 B**, 252.
11. — and Sahay, M. N., *Ibid.*, 1964, **60 B**, 145.
12. — and —, *Ibid.*, 1965, **61 B**, 164.
13. Fogg, G. E., "Extracellular Products," in *Physiology and Biochemistry of Algae*, Ed. R. A. Lewin, Academic Press, N.Y., 1962.

LETTERS TO THE EDITOR

VISIBLE BANDS OF THE BiCl
MOLECULE

THE visible band system ($\lambda\lambda$ 6172-4220 Å) of the BiCl molecule has been known for many years and has been photographed under high resolution by Morgan,¹ Khanna² and Rao and Rao.³ The present study of these bands was undertaken on a new 35 ft. concave grating spectrograph (Singh and Tiwari)⁴ of higher dispersion and resolution with a view to determine more accurately the molecular constants of BiCl.

The bands were conveniently excited by an uncondensed transformer discharge. Exposures of eight hours on Agfa Isopan Plates were sufficient to photograph the bands in the second order with a dispersion of 0.33 Å/mm. An enlargement of the (0,4) band is shown in Fig. 1.

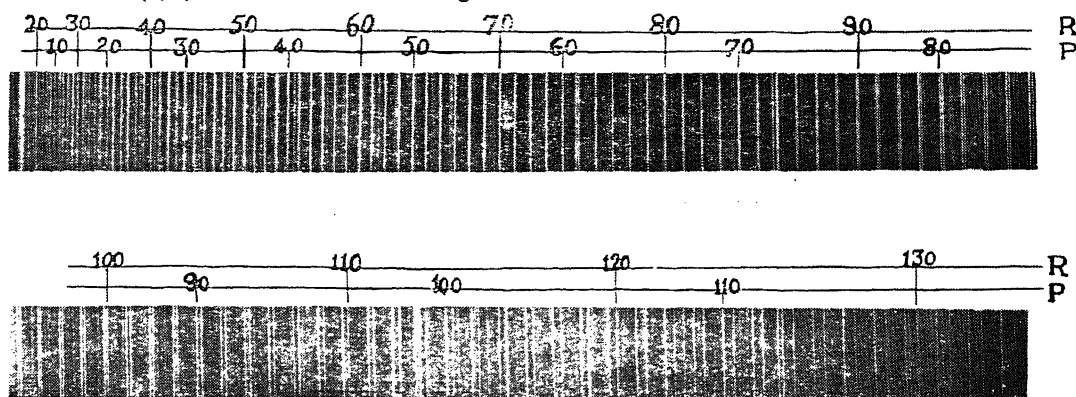


FIG. 1. Band at 4866.5 Å°. (0, 4)

The rotational lines were measured for ten bands, (0,5), (0,4), (0,3), (0,2), (1,1), (1,2), (2,1), (4,0), (3,0) and (2,0), against iron arc standard lines taken from M.I.T. Tables (Harrison, 1939).⁵ An examination of the rotational structure of the bands, revealed the existence of only two branches, P and R, well resolved even for low J values.

Younger and Winans⁶ have shown that a complete and sensitive test for determining the correct numbering of the rotational lines requires:

- the equality of the combination differences $\Delta_2 F(J)$ from two or more bands.
- straight lines on a plot of $\Delta_2 F(J)/(J + \frac{1}{2})$ versus $(J + \frac{1}{2})^2$.

Either (a) or (b) alone will not form a complete test. Thus it was difficult for earlier

workers to fix the J numbering very accurately because the plot mentioned in (b) is very sensitive for low J values.

Revised Rotational Constants for six bands are given in Table I.

TABLE I

Band Assign- ment	B_v' values in cm^{-1}	B_v'' values in cm^{-1}	Band origin in cm^{-1}
0,5	0.0792	0.0899	20243.65
0,4	0.0792	0.0903	20542.42
0,3	0.0792	0.0906	20843.12
4,0	0.0787	0.0916	22587.46
3,0	0.0789	0.0916	22387.62
2,0	0.0790	0.0916	22182.28

$$r_e' = 2.666 \text{ Å} ; r_e'' = 2.478 \text{ Å}$$

Rotational constants for the bands (0,2), (1,1), (1,2) and (2,1) and the details of the analysis will be communicated later.

We are grateful to Professor N. L. Singh and Dr. N. A. Narsimham for valuable discussions. One of us (R.B.S.) is thankful to the C.S.I.R., New Delhi, for financial assistance.

Department of Spectroscopy, RAN B. SINGH.
Banaras Hindu University, K. N. UPADHYA.
Varanasi-5, June 28, 1966.

- Morgan, F., *Phys. Rev.*, 1936, **49**, 41.
- Khanna, B. N., *J. Mol. Spectro.*, 1961, **6**, 319.
- Rao, V. S. and Rao, P. T., *Ind. J. Phys.*, 1965, **39**, 65.
- Singh, R. B. and Tiwari, S. K., *Proc. C.S.I.R. Symposium*, Varanasi, 1963, p. 167.
- Harrison, G. R., *M.I.T. Wavelength Tables*, 1939.
- Younger, P. and Winnans, J. G., *J. Mol. Spectro.*, 1960, **4**, 23.

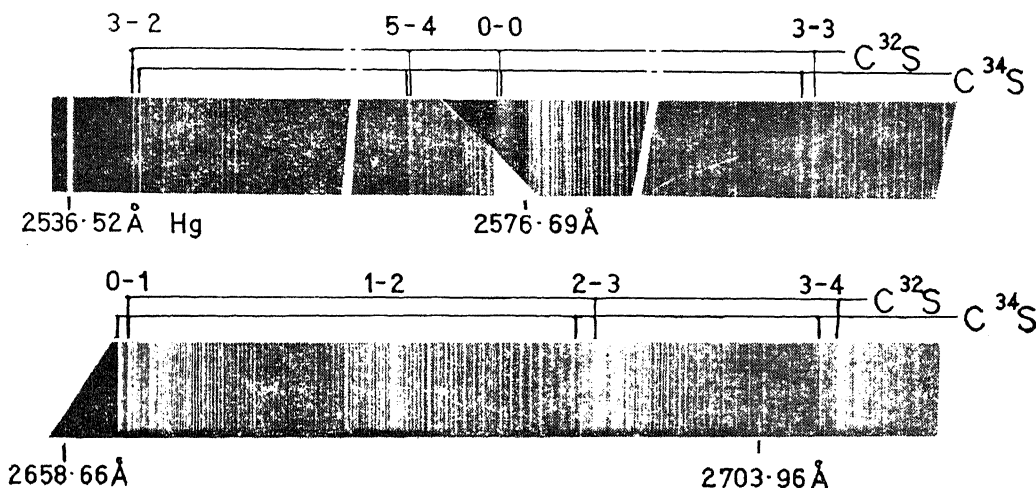
ISOTOPE SHIFTS ($C^{32}S-C^{34}S$) IN THE
BANDS OF THE $A'^1\Pi-X'^1\Sigma^+$ SYSTEM
OF CS^*

ONLY one emission band system in the ultra-violet is known for the CS molecule. Rotational analysis¹ of the bands showed that they arise from an initial $^1\Pi$ to the final $X'^1\Sigma^+$, ground state of the molecule. In the present investigation, vibrational isotope shifts of the bands are studied. Spectra of $C^{32}S$ and $C^{34}S$ are excited in an electrodeless, microwave (2450 mc./s.) oscillator discharge through sulphur, enriched to 44% of ^{34}S and photographed at a dispersion of 0.89 Å/mm. Figure 1 shows some of the bands

due to $C^{32}S$ and $C^{34}S$. The R_1 heads of both the isotopic molecules are measured and their differences, in vacuum wave numbers, are given in Table I. Isotope shifts for the bands are calculated from the following expression and given in column 4 of Table I.

$$\begin{aligned} \nu - \nu' &= (1 - 0.9919) \{1073.4 (\nu' + \frac{1}{2}) - 1285.1 (\nu'' + \frac{1}{2})\} \\ &- (1 - 0.9919^2) \{10.1 (\nu' + \frac{1}{2})^2 - 6.4_6 (\nu'' + \frac{1}{2})^2\} \end{aligned}$$

The vibrational frequencies and anharmonic constants of the $^1\Pi$ and $^1\Sigma^+$ states given above are those derived by Barrow, Dixon, Lagerquist and Wright.² A comparison of the observed and calculated isotope shifts shows a good agree-

FIG. 1. Emission bands of $C^{32}S$ and $C^{34}S$.TABLE I
Isotope Shifts, ν^i ($C^{32}S$) - ν ($C^{34}S$) of the band heads of the $^1\Pi-X'^1\Sigma^+$ system

$\nu' - \nu''$	R_1 band heads of $C^{32}S$ in Å.U	Isotope Shifts in cm^{-1} Observed	Calculated
3-1	2460.3	+13.5	+12.9
4-2	2477.0	+10.4	+10.5
5-3	2493.7	+ 8.5	+ 7.8
2-1	2523.2	+ 7.1	+ 5.3
3-2	2538.7	+ 3.7	+ 3.1
5-4	2572.7	- 1.9	- 1.8
0-0	2575.9	*	- 0.9
3-3	2621.5	- 6.3	- 6.8
0-1	2662.8	-11.1	-11.1
2-3	2693.3	-13.2	-14.4
3-4	2708.9	-15.7	-16.3
4-5	2726.6	(-13.4)	-18.3
5-6	2743.8	-20.5	-20.4
0-2	2754.7	-19.6	-21.1
1-3	2768.9	-21.8	-22.5
2-4	2785.1	-23.7	-24.0
3-5	2801.6	-25.1	-25.7

* The $C^{34}S$ head could not be correctly located because of strong intensity of the $C^{32}S$ head.

ment which confirms the vibrational assignment of the bands.

Spectroscopy Division,
Atomic Energy
Establishment, Trombay,
414 A, Cadell Road, Bombay-28,
June 10, 1966.

N. A. NARASIMHAM.
KUM. SHEILA GOPAL.

* Preliminary results on eight bands were reported at the Indian Science Congress, 1963.

1. Lagerquist, A., Westerlund, H., Wright, C. V. and Barrow, R. F., *Ark. f. Fys.*, 1958, **14**, 387.
2. Barrow, R. F., Dixon, R. N., Lagerquist, A. and Wright, C. V., *Ibid.*, 1960, **18**, 543.

RELAXATION TIMES AND
ACTIVATION ENERGIES OF SOME
DIPOLAR MIXTURES

THE present communication reports the results of dielectric relaxation and activation energies for some simple dipolar mixtures in dilute solutions in the 3 cm. microwave region at the temperature of 20° C. The method employed was the same as reported earlier.¹

TABLE I
Values of relaxation time (τ) and free energy of activation

Polar components	$\tau \times 10^{12}$ sec.	H_τ (K.cal./mole)	Dipolar mixture	$\tau \times 10^{12}$ sec.	H_τ (K.cal./mole)	H_η (K.cal./mole)
Anisaldehyde	.. 14.94	2.63	Anisaldehyde + salisaldehyde	11.62	2.48	2.90
Salisaldehyde	.. 6.87	2.18	Salisaldehyde + <i>o</i> -chlorobenzaldehyde	9.54	2.37	2.90
<i>o</i> -Chlorobenzaldehyde	.. 11.60	2.48	Anisaldehyde + <i>o</i> -chlorobenzaldehyde	14.79	2.62	2.90

Kadaba² has suggested that when the absorption regions of two polar liquids are quite close to each other, one may expect a single relaxation time for their mixture in non-polar solvents. Keeping this in view, the relaxation times of mixtures of anisaldehyde, salisaldehyde and *o*-chlorobenzaldehyde have been determined.

Five solutions of increasing concentrations were made by mixing equal volumes of the two components of the dipolar liquids in benzene. The relaxation time and activation energy for these dipolar mixtures and for their components as observed are given in Table I.

The experimental results for mixtures suggest that for every pair of dipolar mixture in benzene, the relaxation time obtained is the average of two individual relaxation times. These results also show that there is no association in the mixture. This conclusion is in conformity with the fact that in dilute solutions, dipole-dipole interaction is considerably reduced.

The authors are thankful to Dr. P. N. Sharma for encouragement and interest in the work.

Physics Department, N. K. MEHROTRA.
Lucknow University, M. C. SAXENA.
Lucknow, March 9, 1966.

1. Mehrotra, N. K., Shukla, J. P. and Saxena, M. C., *Curr. Sci.*, 1966, **35**, 120.
2. Kadaba, P. K., *J. Phys. Chem.*, 1958, **62**, 887.

CHEMICAL COMPONENTS OF VATERIA INDICA SEEDS

Vateria indica (dipterocarpaceae) is a large ever-green tree indigenous to South-Western India, Kanara and Travancore. It is the source of the Indian Copal resin of commerce. The seeds which are enclosed in a thick hard shell contain usually from 22 to 27% of what is called Malabar or Piney Tallow (Dhupa fat). This oil is credited with medicinal properties. It is used as a local application in chronic rheumatism and other painful afflictions.¹

With a view to study the non-fatty components of this oil, a sample of the seeds was obtained

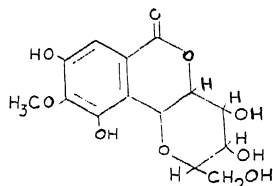
from Shimoga, Mysore. The shell was separated from the kernel and the latter (2.5 kg.) coarsely ground and extracted with a succession of solvents in an extractor. (i) Light petroleum (b.p. 60–80°) yielded only the fat (250 g., 10%). (ii) Subsequent ether extraction at room temperature afforded a small amount (ca. 0.5 g.) of a compound which had no definite m.p. but charred and left a residue on ignition. (iii) Extraction with acetone at room temperature yielded a deep red extract. On partial concentration a viscous brown-red mass was obtained which deposited a small amount of fat and a colourless crystalline compound. The fat was removed by repeated washing with ether and the crystalline compound collected by decantation and washing with methanol (Yield 7 g.; m.p. 155–156°). Complete removal of acetone from the decanted solution gave a dark brown resinous solid which could not be crystallised. The colourless compound crystallised from water or aqueous ethanol in stout rectangular prisms, m.p. 155–156°. Drying at 120° in vacuum for three hours raised the m.p. to 226–228° (Found on dried material: C, 48.9; H, 5.4. Calc. for $C_{14}H_{16}O_9$, $1H_2O$: C, 48.5; H, 5.2%). The compound did not give Molisch test and dissolved in cold sodium hydroxide solution from which it could be recovered on acidification. It dissolved slowly in aqueous sodium bicarbonate and more easily in sodium carbonate, the colourless solution becoming violet on keeping. An alcoholic solution of the compound gave a light green colour with ferric chloride.

Acetylation with sodium acetate and acetic anhydride (140°, 3 hr.) yielded a pentaacetate which crystallised from methanol as colourless hexagonal plates, m.p. 205–206° (Found: C, 53.7; H, 5.0; COME, 40.9. Calc. for $C_{14}H_{11}O_9$ (COME): C, 53.5; H, 4.8; COME, 39.9%).

A solution of the compound in ethanol showed blue fluorescence in UV light; λ_{max} , 275 m μ , λ_{inflex} , 310 m μ (Methanol medium). The IR spectrum had the following peaks: 2.85, 3.02 μ (hydroxyl); 3.35, 3.62 μ (chelated hydroxyl);

5.84 μ (carbonyl) ; 6.18, 6.52 μ (aromatic). The NMR spectrum of the acetate in deuterio chloroform indicated the presence of five acetoxyl groups, two of which were phenolic (at τ 7.66) and the other three alcoholic (at τ 7.9). Signals at τ 6.08 and τ 2.2 were attributed to the 3 protons of the methoxyl group and a lone aromatic proton respectively.

The above properties indicated close resemblance of the colourless compound with bergenin (I).²⁻⁶ Comparison of the acetate with an authentic sample⁴ confirmed the identity. Dean *et al.*⁶ found bergenin to be inactive at a concentration of 1:1000 *in vitro* against *Entamoeba histolytica*. However, an aqueous decoction from three herbal plants, *viz.*, *Didymocarpus pedicellata*, *Bergenia ciliata* and *Bergenia ligulata* has been claimed to be successful for dissolving stone in kidney and bladder by Ayurvedic experts. The role of bergenin in this as well as in other drugs is yet unknown.



I. Bergenin

(iv) Continued extraction with ethanol of the residual seeds yielded an extract which on concentration yielded a very small amount of sucrose. Complete removal of the solvent afforded a brown-red viscous resin. Paper chromatography of the concentrate using *n*-butanol-pyridine-water (6:4:3) and aniline hydrogen phthalate as spraying reagent indicated the presence of glucose and mannose in it.

Since the commercial oil is obtained by boiling the crushed seeds with water there was a possibility of its containing bergenin. A sample of it was therefore extracted in a liquid-liquid extractor with ethanol. The ethanolic extract was tested for the presence of bergenin and it was found to be absent.

The results indicate that the seeds of *Vateria indica* contain a solid fat, a novel C-glucoside bergenin besides sucrose and traces of other sugars but the oil extracted from it by means of solvents or by the crude village process is free from polyphenols.

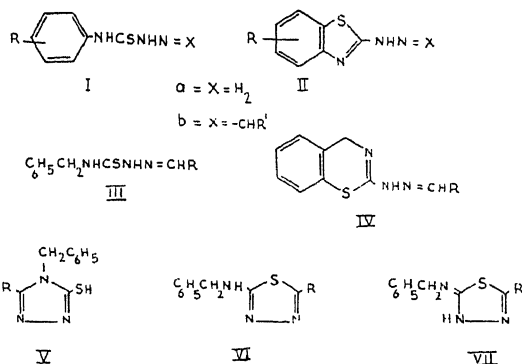
Dept. of Chemistry,
University of Delhi,
Delhi-7, June 2, 1966.

S. C. BHRARA.
T. R. SESHADRI.

1. Nadkarni, K. M. and Nadkarni, A. K., *Indian Materia Medica*, Vol. 1, p. 1265.
2. Posternak, T. and Durr, K., *Helv. Chem. Acta*, 1958, **41**, 1159.
3. Hay, J. E. and Haynes, L. J., *J. Chem. Soc.*, 1958, p. 2231.
4. Aiyar, S. N., Jain, M. K., Krishnamurti, M. and Seshadri, T. R., *Phytochemistry*, 1964, **3**, 335.
5. Carruthers, W. R., Hay, J. E. and Haynes, L. J., *Chem. and Ind.*, 1957, p. 76.
6. Dean, B. M. and Walker, J., *Ibid.*, 1958, p. 1696.

OXIDATIVE CYCLISATION OF SOME 4-BENZYLTHIOSEMICARBAZONES

DURING the course of an extended study¹⁻⁴ of the oxidative cyclisation of 4-arylthiosemicarbazides (Ia) and 4-arylthiosemicarbazones (Ib) under different conditions, it was demonstrated⁴ that the oxidation of 4-arylthiosemicarbazides and-thiosemicarbazones by bromine in chloroform leads respectively to the formation of 2-hydrazinobenzthiazoles (IIa) and their benzylidene derivatives (IIb). It was thus of interest to investigate whether 4-benzylthiosemicarbazones (III) would undergo such a cyclisation to yield the benzo-1,3-thiazine system (IV) in addition to the other three conventionally obtainable products, *viz.*, 3-mercapto-*s*-triazoles (V), 2-benzylamino-1,3,4-thiadiazoles (VI) and 2-benzylamino- Δ^4 -1,3,4-thiadiazolines (VII).



It has now been shown that the oxidation of III (R = aryl residues) by bromine in chloroform gave only two sets of products in varying proportions; alkali-soluble components to which the 3-mercapto-*s*-triazole structure (V) was assigned and the other—alkali-insoluble products—characterised as 2-benzylamino-5-aryl-1,3,4-thiadiazoles (VI). The latter structure was also authenticated by the direct obstenction of VI through ferric chloride oxidation^{1,5} of III (R = aryl residues). The yields of the 3-mercapto-*s*-triazoles (V) varied between 50–80%, while the thiadiazoles were formed in

lesser yields, ca. 10–30%, along with considerable amounts of resinous material.

When bromine in carbon tetrachloride was used as the oxidising agent, both types (V) and (VI) were obtained as with bromine in chloroform. In this case, however, the thiadiazoles (VI) were the major products (55–80% yield) with lesser amounts of resinous material. The triazoles (V) were obtained in 1–30% yields. Oxidation of III by bromine in acetic acid gave exclusively the triazoles (V) in 60–85% yields. On the other hand, when N-bromosuccinimide in carbon tetrachloride was the oxidising agent, (VI) was almost the sole product, in yields varying between 60–90%.

Full details regarding the scope and mechanism of this reaction will be published elsewhere.

The authors are thankful to Prof. N. V. Subba Rao for providing the facilities. One of the authors (T.R.V.) is grateful to the C.S.I.R. for the award of a Junior Research Fellowship.

Department of Chemistry, T. RADHA VAKULA.
Osmania University, V. RANGA RAO.
Hyderabad-7, May 10, 1966. V. R. SRINIVASAN.

1. Ramachander, G. and Srinivasan, V. R., *J. Sci. and Ind. Res.*, 1962, **21C**, 44.
2. — and —, *Ibid.*, 1962, **21C**, 70.
3. — and —, *Ind. Jour. Chem.*, 1963, **1**, 234.
4. Ranga Rao, V. and Srinivasan, V. R., *Experientia*, 1964, **20** (4) 200.
5. Young, G. and Eyre, W., *J. Chem. Soc.*, 1901, p. 54.

EFFECT OF ZINC-OXIDE-CHROMIA ADDITIVE IN PALLADIUM CATALYST ON ACETYLENE

HYDROPOLYMERIZATION REACTION

Among the various additives, ZnO-Cr₂O₃ combination has been reported¹ to be highly effective in promoting the synthesis of dimers containing butadiene as the main component from palladium-catalysed reaction between acetylene and hydrogen. In the present investigation the effect of varying the ZnO-Cr₂O₃ concentration in palladium catalyst on the extent and pattern of acetylene conversion was studied for which Pd : ZnO : Cr₂O₃ : kieselguhr of four different compositions were employed, besides two other compositions having no kieselguhr in one and no ZnO-Cr₂O₃ in the other. The compositions of the catalysts are given in Table I. In the catalysts containing the additives, the percentage (by weight) of ZnO-Cr₂O₃ varied while the percentage of Pd (0.01825) and the Zn : Cr atomic ratio (1 : 1) were kept almost constant.

Experiments with all the catalysts were conducted under identical conditions in a flow

TABLE I
Composition of catalysts (% by weight)

	Pd	ZnO	Cr ₂ O ₃	Kieselguhr	Atoms Zn	Atoms Cr
1.	0.01825	4.56	4.20	91.22	0.056	0.055
2.	0.01827	8.38	7.78	83.82	0.103	0.102
3.	0.01827	14.45	13.29	72.24	0.178	0.176
4.	0.01821	22.62	20.81	43.45	0.278	0.274
5.	0.01825	52.00	48.00	..	0.639	0.631
6.	0.01825	..	..	100.00	..	..

system under atmospheric pressure at a temperature of 270° C., volumetric space velocity of 1640 hr.⁻¹ (at N.T.P.) and using a feed having C₂H₂ : H₂ : N₂ mole ratios of 2 : 2 : 1, inert nitrogen being added only to facilitate material balance. Results of once-through conversion are recorded in Table II and the corresponding conversion patterns are plotted in

TABLE II
Effect of ZnO-Cr₂O₃ additive in Pd-catalyst
on yields of products

Wt. % ZnO-Cr ₂ O ₃ in catalyst*	Percentage of C ₂ H ₂ converted to products (in one pass)				
	C ₄ H ₆ -1, 3	C ₄ H ₈	C ₂ H ₄	Oil	Total
0	4.7	6.8	50.0	22.0	83.5
8.76	8.0	5.0	42.0	28.0	83.0
16.16	10.1	3.2	37.3	27.2	77.8
27.74	9.1	2.8	33.0	25.2	70.1
43.43	7.0	1.9	23.8	19.1	51.8
100.00†	3.6	0.9	17.3	10.1	31.8

* Catalyst having almost a constant concentration (0.01825% by weight) of Pd.

† Catalyst: Pd ZnO-Cr₂O₃ (0.01825 : 52 : 48).

Fig. 1. It is evident from the results that the increase in the proportion of ZnO-Cr₂O₃ additive in the lower range increases the relative yields of butadiene-1, 3 and oil (> C₄) and reduces those of ethylene and butenes. Besides enriching the primary² reaction product, butadiene-1, 3, at the cost of secondary products, viz., butenes, the incorporation of small amounts of ZnO-Cr₂O₃ in Pd-catalyst also increases the degree of unsaturation of the oil product as is evidenced by the higher values of 'refractive index' and 'unsaturation number' of its similar boiling range fractions. ZnO-Cr₂O₃ additive in Pd-catalyst may, therefore, be looked upon as a 'selectivity promoter' having the function of decreasing the degree of product saturation. This may involve poisoning the catalyst sites active for secondary hydrogenation of unsaturated primary products of acetylene hydropolymerization. On the other hand, the fact that the overall conversion of acetylene declines over the entire range of increasing ZnO-Cr₂O₃ concentration in Pd-

catalyst having identical wt. % concentrations of Pd may be suggestive of the reduction of catalyst surface area due to $\text{ZnO-Cr}_2\text{O}_3$ incorporation.

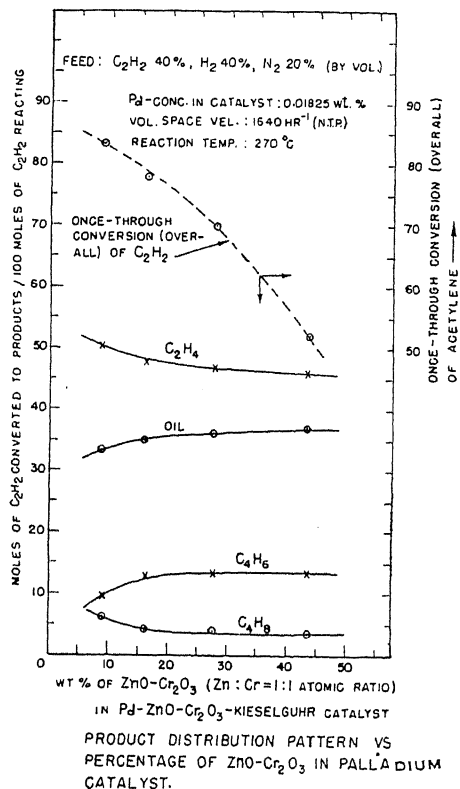


FIG. 1

Authors' sincere thanks are due to Prof. N. R. Kuloor for his keen interest in this investigation and to the C.S.I.R., New Delhi, for the award of a Research Fellowship to one of them (M.C.).

Dept. of Chemical Engg., MANAS CHANDA.
Indian Institute of Science, S. S. GHOSH.
Bangalore-12, August 1, 1966.

1. Tadao Shiba, *Repts. Govt. Chem. Ind. Res. Inst., Tokyo*, 1954, **49**, 287.
2. Manas Chanda and Ghosh, S. S., *Curr. Sci.*, 1965, **34** (17), 508.

CARDIOACTIVE GLYCOSIDES FROM MELODINUS MONOGYNOUS "ROXB"

Melodinus monogynous (Syn. *Nerium pisidium*) is a medicinally efficacious climbing shrub, found abundantly in Assam, Sikkim and Sylhet. Its bitter roots have been reported to possess hypnotic and antimalarial properties.^{1,2}

Chatterjee and co-workers³ isolated a glucoside melodin ($\text{C}_{25}\text{H}_{36}\text{O}_8 \cdot \text{H}_2\text{O}$, M.P. 128° C.) which yielded melodinin and D-glucose on hydrolysis. However, the chemical nature of melodinin has not yet been ascertained.

Reichstein *et al.*^{3,4} have extensively investigated other species of *Nerium* (*Nerium odorum*⁶ and *Nerium oleander*,^{7,8}) and found that they were rich source of digitalis glycosides. This led the present authors to reinvestigate the roots of *Melodinus monogynous* for the detection and characterisation of its cardiotonic constituents. Our preliminary investigations indicated the presence of several digitalis type of glycosides in its root bark.

The dried and powdered roots, collected in Assam, were extracted by percolation with 50% to 90% aqueous alcohol. The alcoholic extract was concentrated under reduced pressure, treated with freshly prepared lead hydroxide to remove the tannin contents, and filtered. The purified aqueous concentrate was shaken with ether, chloroform and chloroform-alcohol (2:1) successively for the separation of the cardenolides of different polarities.

The paper-chromatographic controls of various fractions, using Kaiser systems⁹ [benzene-chloroform (7:5) saturated with formamide and chloroform saturated with formamide] revealed the presence of a total of nine Kedde positive^{10,11} constituents. They have been provisionally named as α , β , A, B, C, D, E, F and G. However, α and β could not be detected in the original ether extract, their presence was detected in paper-chromatogram using benzene-cyclohexane (1:1) saturated with formamide system in the mother liquor of substance A only after the separation of ether fraction ingredients by column chromatography over neutral alumina. They were separated by preparative paper-chromatography.

The less polar substances A, B, C and D were obtained in paper-chromatographically pure state by adsorption chromatography over neutral alumina and silica gel. The more polar substances E, F, and G were separated by partition chromatography¹² over Celite 535 using formamide as a stationary phase and chloroform saturated with formamide as the mobile phase. The properties of eight isolated crystalline substances are being listed in Table I.

We are grateful to Dr. A. C. Roy and Mr. B. N. Kaul, Processing and Development Division, C.D.R.I., Lucknow for their assistance in the extraction of plant material and to Dr. R. Neher, Ciba, Basel, for the analysis.

TABLE I

Substance	M.P. °C.	Solvent of crystallisation	[α] _D in Methanol	Analysis			
				Calculated		Found	
				%C	%H	%C	%H
Substances* a	.. 101-103	Acetone	-10	..	..	..	..
" A (C ₂₅ H ₃₈ O ₄)	.. 188	Acetone-pentane	-45	75.34	9.24	75.23	9.81
" B†	.. 246	Acetone-ether	..	..	..	..	..
" C (C ₂₃ H ₃₄ O ₆)	.. 228- 32	MeOH-ether	+56	67.95	8.43	68.40	8.60
" D (C ₃₇ H ₅₂ O ₁₆)	.. 98-100	Acetone-ether/water	-26	59.03	6.96	58.90	7.11
" E (C ₃₅ H ₅₂ O ₁₄)	.. 118-124	Chloroform-ether/water	-26	60.30	7.50	59.70	7.50
" F (C ₂₅ H ₄₄ O ₉)	.. 182- 84	Isopropanol-water	-24	64.91	8.26	65.39	8.46
" G*	.. 220-225	Alcohol-water	..	..	..	..	..

* They could not be analysed, due to their small amounts; † Identified as digitoxigenin by mixed M.P. with authentic sample and comparison of its R_f on paper-chromatogram.

Dept. of Chemistry, S. O. D. BHATNAGAR.
Lucknow University, M. P. KHARE.
Lucknow, April 18, 1966.

1. Watt, G., *Dictionary of Economic Products of India*, Govt. of India Press, Calcutta, 1891, Part 5, p. 226.
2. Wehmer, C., *Die Pflanzenstoffe*, Gustav Fischer, Jena, 1931, 2, 978.
3. Chatterji, S. K., Sharma, V. N. and Dhar, M. L., *J. Sci. Ind. Res.*, 1954, 13B, 546.
4. Vischer and Reichstein, T., *Helv. chim. Acta*, 1944, 27, 1332.
5. Rangaswami, S. and Reichstein, T., *Ibid.*, 1949, 32, 939.
6. — and —, *Pharm. Acta. Helv.*, 1949, 24, 159.
7. Neumann, W., *Ber.*, 1937, 70, 1547.
8. Jäger, H., Schindler, O. and Reichstein, T., *Helv. Chim. Acta*, 1959, 42, 977.
9. Kaiser, F., *Ber.*, 1955, p. 557.
10. Kedde, D. L., *Dissertation (Leyden)*, 1946.
11. Bush, I. E. and Taylor, D. A. H., *Biochem. J.*, 1952, 52, 643.
12. Lichti, H., Tamm, Ch. and Reichstein, T., *Helv. chim. Acta*, 1956, 39, 1914.

STUDIES ON THE EFFECT OF CHLORO CHOLINE CHLORIDE ON THE EARLY ROOT GROWTH OF RICE

CHLORO CHOLINE CHLORIDE (CCC) a new growth regulator is known to retard longitudinal growth of plants. Its action is possibly based on the physiological effects of certain ammonium bases, which may be considered as antagonistic to the effect of gibberellins. It has been observed that the addition of gibberellic acid (GA) can reduce the inhibitory effect of CCC on various plants.^{1,2} It is also noticed that inhibitory effect of certain growth regulators like maleic hydrazide can be minimised by the addition of certain heavy metals like Mn, Cu, Co, Zn, Ni and Mo.³ The present investigation is aimed to determine the effect on root elongation in rice by CCC alone and in combination with gibberellic acid and micronutrients.

Seeds of an early variety of rice, Ptb. 10 were soaked in water for 24 hours and germinated in petri plates on a filter-paper at 30° C. The seeds after sprouting (initial length of the root is almost zero) were kept suspended from a filter-paper along the side of the specimen tube (3" × 1") for measurement of root elongation in different concentrations of test solutions. Ten such seeds were kept in each tube. Each treatment was replicated thrice. The tubes were kept in a dark chamber at a room temperature (22° C.) and root growth measurements were recorded after 60 hours. The results presented in Table I indicate a significant inhibition in root growth of rice at 500 and 1,000 ppm concentration of CCC.

Similar tests were conducted to study the optimum concentration of gibberellic acid (GA) for stimulation of root growth in rice at 0, 1, 10, 50 and 100 ppm. The results in Table I

TABLE I

Mean length of the root in mm.

Concentration (ppm)	CCC	GA
Control	33.3	33.3
1	—	35.0
10	37.4	39.7
50	30.8	40.1
100	32.9	31.7
500	13.2	—
1000	9.7	—
C.D. (0.05)	5.9	Not significant.

show that root growth is considerably stimulated at 50 ppm level.

With a view to ascertain if the root inhibition noticed at 500 ppm of CCC could be minimised by addition of GA (50 ppm) or a micronutrient solution containing Fe (10 ppm) concentration further experiments were conducted adopting the same technique described above. The micronutrient used in the study

was M-1761 of Dow Chemical Co. containing Fe 2.9%, Zn 1.45%, Mn 1.45% and Cu 0.8%.

The treatments along with the data on root growth presented in Table II indicate that inhibitory effect of CCC at 500 ppm on root growth can markedly be minimised by addition

TABLE II

Treatment	Root length (mm.)	% over control
Control	22.9	100.0
CCC 500 ppm	13.6	59.3
CCC+GA	21.7	94.8
CCC+Micronutrient	19.4	84.7
GA alone	35.6	155.5
Micronutrient alone	30.8	134.5
C.D. (0.05)	7.9	-

of GA (50 ppm) or micronutrient solution containing 10 ppm level of Fe.

The inhibition of root growth under CCC may presumably be due to destruction of growth-promoting auxin or enzyme. The fact that the promotion of root growth by addition of GA in presence of CCC may be attributed to inactivation of enzyme system but not auxin as the GA cannot act in the absence of auxin.^{4,5} The recovery of inhibitory growth of CCC by the addition of micronutrient suggests that the effect of CCC is more on inactivation of heavy metal catalysed enzymic systems than destruction of auxins of the root tissue.

The authors are thankful to M/s. Cyanamid International, Wayne, New Jersey, for supply of samples of CCC and to Dr. R. H. Richharia, Director, for the interest he evinced in this investigation.

Central Rice Res. Inst., CH. NARASINGA RAO.
Cuttack, India, K. SRINIVASULU.
March 21, 1966.

1. Wittwer, S. H. and Tolbert, N. E., *Pl. Physiol.*, 1960, 35, 371.
2. Tolbert, N. E., *Ibid.*, 1960, 35, 380.
3. Suda, S., *Plant and Cell physiol.*, 1960, 1, 247.
4. Brian, P. W. and Hemming, H. G., *Ann. Bot.*, Lond., 1958, 22, 1.
5. Kuse, G., *Bot. Mag. Tokyo*, 71, 151.

ROCK ATTENUATION AND INTERNAL FRICTION AS A FUNCTION OF FREQUENCY

In order not only to perform realistic seismic computations but also to make valid assessments of the elastic moduli of rocks using wave transmission methods, it is necessary to know how wave attenuation varies with frequency. An associated problem concerns the relationship between internal friction and frequency in rocks.

Without citing individual references, earlier conclusions as to these relationships have been based on broad extrapolations from seismic, field and laboratory data derived over individually limited ranges of frequency. In order to be able to express these generalised relationships quantitatively with a higher degree of confidence, we have accumulated our own and other published data (recalculated and reconstituted where necessary) and have conducted hitherto unpublished experimental work in order to cover a very wide frequency band extending from the lower limit of recordable seismic frequencies (around 10^{-3} c/s.) and well into the upper ultrasonic range (10^8 c/s.).

The detailed arguments and analytical techniques are being published at length elsewhere. Meanwhile, the main quantitative relationships that have emerged from the statistical analyses are as follows:

(a) Seismic R-wave: 44 coordinates from 14 authors

$$\gamma = 5.835 \times 10^{-3} f^{1.005} \text{ Km}^{-1}, 10^{-3} < f < 1$$

$$a = 5.068 \times 10^{-7} f^{1.005} \text{ dB. cm}^{-1}, 10^{-3} < f < 1$$

$$r = 0.835 \text{ (42 degrees of freedom); condition that } 0.296 < r \leq 1 \text{ is well satisfied.}$$

(b) 'Field' and Ultrasonic (P-wave): 122 coordinates from 12 authors

$$a = 1.012 \times 10^{-5} f^{0.911} \text{ dB. cm}^{-1}, 1 < f < 10^8$$

$$r = 0.943 \text{ (120 degrees of freedom); condition that } 0.178 < r \leq 1 \text{ is well satisfied.}$$

(c) If we take a statistically composite picture of this data (R and P) we obtain:

$$a = 1.99 \times 10^{-6} f^{1.0386} \text{ dB. cm}^{-1}, 10^{-3} < f < 10^8$$

where:

- a = spatial attenuation exponent,
- γ = temporal attenuation exponent,
- f = frequency,
- r = correlation coefficient.

These analyses refer to data on sedimentary rocks only and show that the general assumption of wide-band linearity, frequency/attenuation, is justified. The constants are now being appraised with respect to current seismic records.

Q (reciprocal internal friction) values have been recalculated from published data referred to P,S,R,L, waves, the inherent difficulties (e.g.) dispersion and assumptions in the analysis being outlined in the longer text. Statistically, we are left with the relationship:

$$\bar{Q} = 213 f^{-0.015}, 10^{-3} < f < 10^7$$

which of course suggests that, subject to the limits of current data availability, Q is virtually independent of frequency. Quantitatively, this mean figure of 213 for Q is of limited value

due to the intrinsic sensitivity of the individual Q's to pressure and temperature. The result of the exercise does, however, support the often-made assumption in seismic analysis that Q is indeed independent of frequency.

This work was conducted as part of the rock mechanics programme at the Post-graduate School in Mining, at the University of Sheffield and our thanks are to Dr. A. Roberts, Director of Post-graduate School in Mining, for facilities and to U.K. Safety in Mines Research Establishment for financial assistance.

University of Durham, P. B. ATTEWELL.
Science Laboratories,
Durham City, England
and

National Geophysical Res. Inst., Y. V. RAMANA.
Hyderabad, June 22, 1966.

ON UNUSUAL PHOSPHATE- PHOSPHORUS CONCENTRATION IN SURFACE SEA-WATER OFF THE COAST OF VISAKHAPATNAM

THIS note refers to the data on Phosphate-Phosphorus described in our paper 'Studies on diurnal variations in the hydrobiological conditions off the Waltair coast' during the 1958-59 period⁵ off the Visakhapatnam coast. In the light of the additional information obtained on the distribution and seasonal changes of Phosphate-Phosphorus during subsequent years and also on board R. V. Anton Bruun of the U.S. Program in Biology under International Indian Ocean Expedition, we wanted to draw special attention to the unusual $\text{PO}_4\text{-P}$ values observed at an inshore station during a 24 hour period on 24/25 February 1959.⁵

The highest and the lowest values for $\text{PO}_4\text{-P}$ recorded at the inshore station during this period were 2.25 to 1.25 $\mu\text{g. at/L}$. These values may be considered rather high and unusual for the surface waters of the Bay of Bengal, for the monthly average values for the inshore waters off the Visakhapatnam coast range between 0.09 and 1.17 $\mu\text{g. at/L}$. It may also be mentioned that the monthly mean $\text{PO}_4\text{-P}$ values during October 1958 to May 1959, when more than 30 diurnal cycles of variation were studied, was from 0.23 to 1.19 $\mu\text{g. at/L}$. It was also generally noticed that high tide brought in high phosphate values and low tide low values.

It is on record that on many occasions, however, the phosphate-phosphorus has shown high concentrations in the inshore waters of the Bay of Bengal. Values as high as 1.5 to 1.8 $\mu\text{g. at/L}$ have been encountered in our work on

the hydrography of the region. Ganapati and Ramasarma,¹ Ganapati and Subba Rao,² Jayaraman³ and Ramamurthy⁴ have all reported high values like 1.66, 1.37, 3.00 (once recorded) and 1.198 $\mu\text{g. at/L}$ respectively. At the Visakhapatnam harbour one of the possible causes for high and irregular values is the periodical dredging of the harbour area. It may also be due to upwellings off the coast of Waltair.

When such high values are averaged to arrive at monthly mean values, the real picture of the distribution of the $\text{PO}_4\text{-P}$ in the sea-water gets distorted. In our study we arrived at the monthly mean values by averaging the data collected during 12 observations in a diurnal cycle and 3 to 4 such diurnal cycles in a month. Consequently high values got smoothed out and as such the monthly mean values did not bring out the finer details of the $\text{PO}_4\text{-P}$ distribution in space and time. This may be true for other factors as well. It is also possible to visualize the existence of 'patchiness' of concentrated phosphate-rich waters here and there in the sea and such waters and their significance will be missed when values are averaged or the data are collected at greater intervals of time and space. In fact the study on chemical and biological fluctuations during diurnal cycles⁵ has shown that the daily range of variation of some of the factors was of the same magnitude as the annual range.

We wish to thank Dr. N. K. Panikkar, Director, National Institute of Oceanography, CSIR, for his helpful suggestions.

National Inst. of T. S. SATYANARAYANA RAO.
Oceanography,
Bombay

and

Central Public Health V. CHALAPATI RAO.
Engg. Inst., Nagpur, June 2, 1966.

1. Ganapati, P. N. and Ramasarma, D. V., *Andhra Univ. Mem. Oceanogr.*, 1958, 62 (2), 168.
2. — and Subba Rao, D. V., *Proc. Ind. Acad. Sci.*, 1958, 48, 189.
3. Jayaraman, R., *op. cit.*, 1951, 33 B, 92.
4. Ramamurthy, R., *J. Madras Univ.*, 1953 B, 23 B, 148.
5. Satyanarayana Rao, T. S. and Chalapati Rao, V., *J. Mar. Biol. Ass. India*, 1962, 4 (1), 23.

A NEW SPECIES OF UREDO ON HYGROPHILA

THREE rusts have been previously described on species of *Hygrophila* (See Laundon, 1963), these are:

1. *Puccinia cacao* McAlp. is a heteroecious rust with pycnia and aecia on *Hygrophila* and uredia and telia on *Rottboellia* (Gramineae).

2. *Maravalia hygrophilae* (Syd. and Butl.) Mains is known only in the telial stage. It is recorded only in India and on *H. quadrivalvis* and *H. salicifolia*. The rust described here might be the uredial stage of this rust but there is no evidence of this connection.
3. *Uredo hygrophilae* Syd. is similar to the rust described here in being the only other rust on Acanthaceae having urediospores with 2-3 pores but it differs in having larger thicker walled and paler coloured urediospores. *U. hygrophilae* is recorded only from the Philippines and on *H. philomoides* and *H. salicifolia*.

As the present rust cannot be placed with any of these three rusts or with any other rust on Acanthaceae it is described as a new species :

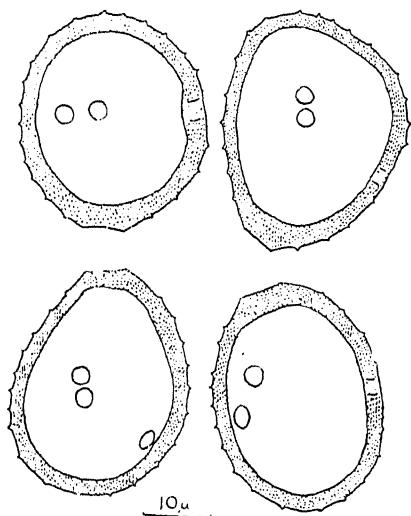


FIG. 1. *Uredo hygrophilicola* urediospores.

Uredo hygrophilicola G.F. Laundon and K. M. Ponnappa, sp. nov.

Pycnia et *aecia* adhuc ignota. *Uredia* plerumque epiphylla, inaequaliter dispersa aut in catervis usque ad 2 mm. diam. concentrica, atro-brunnea, 0.4-0.8 mm. diam. *Urediosporae* late ellipsoideae vel obovovoidae, $26-36 \times 21-24 \mu$; membrana senata vel umbrina, subtiliter echinulata, $1\frac{1}{2}-2\frac{1}{2} \mu$ crassa; 2-3 poris, plus vel minus aequatorialibus. Typus in *Hygrophila quadrivalvi*, India (Kerala), IMI 103591.

Pycnia and *aecia* unknown. *Uredin* mostly epiphyllous, irregularly scattered or concentrically arranged in groups up to 2 mm. diam., dark brown, 0.4-0.8 mm. diam. Urediospores broadly ellipsoidal to obovoidal, $26-36 \times$

$21-24 \mu$; wall sienna to umber, finely echinulate $1\frac{1}{2}-2\frac{1}{2} \mu$ thick; 2-3 pores more or less equatorial. Type on *Hygrophila quadrivalvis*, India (Kerala), IMI 103591.

We are indebted to Miss S. Daniels for checking the Latin diagnosis.

Horticultural Research G. F. LAUNDON.

Laboratory,
P.O. Box 241, Levin, New Zealand,
and

469, VIII Cross Road, K. M. PONNAPPA.
Vyalikaval Extension P.O.,
Bangalore-3, April 25, 1966.

1. Laundon, G. F., 'Rust Fungi, I. On Acanthaceae,' *Mycol. Pap. C.M.I.*, 1963, 89, 1.

INHERITANCE OF HOST REACTION TO RACES A 20 AND A 22 OF *USTILAGO* *AVENAE* (PERS.) ROSTR.*

STUDIES on the inheritance of host reaction to *Ustilago avenae* (Pers.) Rost. and *U. kolleri* Wille involving a number of oat varieties of widely different genetic make-up revealed that resistance to oat smut races was controlled by a variable number of genetic factors (Cochran *et al.*, 1944; Fischer and Holton, 1957; Hanna and Popp, 1930; Holton, 1959; Reed, 1925, 1942). The number that can be identified depends upon the variety, source of resistance, and pathogenic races involved (Narain, 1962). With one exception in the covered smuts (Reed and Stanton, 1937) all reports indicated that resistance to the oat smut pathogens is controlled by dominant gene action.

Although attempts have been made to determine the distribution and host range of oat smut races of the south-eastern United States (Luke *et al.*, 1960, 1961; Morey, 1955), no attention has been given to the mode of inheritance of resistance to these races. Studies reported here were meant to determine the nature of resistance to two of the most commonly occurring races of south-eastern United States.

One hundred F_2 plant families of Fulgrain Strain 7 (C.I. 4389) \times Fulgrain Strain 3 (C.I. 3697) were used to study the inheritance of host reaction to races A 20 and A 22 of *U. avenae*. Two grams of seed per treatment were weighed from each of the 100 F_2 families and two replications were used for each treatment. Seeds were inoculated by Allison's (1937) partial vacuum technique. The inoculated seeds were planted in 5-foot rows in field plots. Seeds of each parent variety (Fulgrain Strain 7 and Fulgrain Strain 3) were also inoculated with A 20

and A 22 and planted as checks. Fulgrain Strain 3 is susceptible to A 22 and resistant to A 20 whereas Fulgrain Strain 7 is susceptible to A 20 and resistant to A 22. Infection percentages were calculated for each row on a plant basis (number of smutted plants per row ÷ total number per row × 100). The test in which race A 22 was used was repeated; however, only one test was carried out with race A 20.

Results of this study are presented in Table I. The experimental evidence indicates that susceptibility is dominant when the reaction to race A 22 is considered. As far as the author is aware this constitutes the first report that resistance to loose smut oats is controlled by recessive gene action. On the contrary, the reaction of plants from the same hybrid to race A 20 indicates that resistance is dominant and susceptibility is recessive.

TABLE I

Race	Parents (checks)		Fulgrain 7 × Fulgrain 3			
	% infection		1961 test		1962 test	
	Fulgrain 7	Fulgrain 3	No. of infected plants	No. of healthy plants	No. of infected plants	No. of healthy plants
A 20	70	0	24 (1-74% infection)	76	..	..
A 22	0	95	72 (1-75% infection)	28	75 (1-92% infection)	25

During 1962 the test with race A 20 could not be repeated.

The statistical analysis of data indicates monogenic inheritance of host reaction. To test the independence of loci, infection percentages were separated (1-10%, 11-20%, 21-30%, and above 30% infection) into various classes. The data did not fit 9 : 3 : 3 : 1 ratio. Linkage tests, however, indicate that no improvement in fit was possible. Therefore, classification difficulties were assumed to be responsible for the deviation from independence and the two loci were either independent or on separate chromosomes.

Department of Mycology and A. NARAIN.

Plant Pathology,
College of Agriculture,
Orissa University of Agriculture and
Technology,
Bhubaneswar-3 India, May 4, 1966.

* A portion of Doctoral Dissertation in Plant Pathology, submitted to the Graduate School, University of Florida, U.S.A., in 1962.

1. Allison, C. C., *Minnesota Agric. Exp. Sta. Tech. Bull.*, 1937, **119**, 1.
2. Cochran, G. W., *et al.*, *J. Agric. Res.*, 1944, **70**, 43.
3. Fischer, G. W. and Holton, C. S., *Biology and Control of the Smut Fungi*, The Ronald Press Co., New York, 1957, pp. 622.
4. Hanna, W. F. and Popp, W., *Canada Sci. Agric.*, 1930, **11**, 200.
5. Holton, C. S., *Plant Pathology—Problems and Progress*, Univ. of Wisconsin Press, 1959 p. 145.
6. Luke, H. H., *et al.*, *Phytopathology*, 1960, **50**, 209.
7. —, *Ibid.*, 1961, **51**, 490.
8. Morey, D. D., *U. S. Dept. Agric. Plant Dis. Repr.*, 1955, **39**, 960.
9. Narain, A., *Doctoral Dissertation*. University of Florida, U.S.A., 1962, p. 72.
10. Reed, G. M., *Mycologia*, 1925, **17**, 163.
11. —, *Amer. J. Bot.*, 1942, **29**, 308.
12. Reed, G. M., *et al.*, *J. Amer. Soc. Agron.*, 1937, **29**, 997.

MULTIPLE RESISTANCE TO HEAT, DROUGHT, FROST, CHARCOAL ROT AND NEMATODE IN COMMERCIAL POTATO

THE potato crop on the existing commercial varieties under higher thermoperiods gives poor yield due to the effect of higher temperature and susceptibility to drought. Additional problem is created by root-knot nematode and charcoal rot diseases common to regions of high temperature during potato crop period. Therefore, the varieties incorporating multiple gene resistance to these four attributes are the imperative need for successful potato cultivation in these regions. In an earlier communication, success in breeding varieties suitable for these regions, incorporating tolerance to higher thermoperiods and charcoal rot, was indicated (Khanna, 1966). The present note deals with efforts to breed varieties incorporating resistance to root-knot nematode and charcoal rot with tolerance to higher thermoperiods and drought.

The population of 519 HB selections reported earlier (Khanna, 1966) were in addition to thermoperiod tolerances, screened for resistance to drought. For this, the watering was stopped in the potted plants of the entire population kept at the day temperature of 45°C and night temperature of 30°C. At this treatment, the controls (Up-to-Date and Kufri Red) showed severe wilting and dried within two days. After a week the watering was resumed and seven selections regained growth in the sequence HB 829, 1201, 1245, 1244, 836, 835 and 1255. This was an indication of the potentialities of these selections for tolerance to severe drought.

TABLE I
Tolerance to heat, drought, frost, nematode and charcoal rot

Tolerant to drought	Tolerant to heat									
	HT		T		MT		S			
HT	1F	41	9N							
T	2F	2	6F	45	1C	3	10F	100	1C	
MT	2F	3	4F	6	1C	29	3C	13	1C	
S		114	1F	72		106		159		

HT = Highly tolerant, T = Tolerant, MT = Moderately tolerant, S = Susceptible, N = Nematode resistant types, C = Charcoal rot resistant types, F = Frost resistant types.

Selection HB 829, which appeared best, was later crossed with Kufri Red (a short-day adapted high yielding variety). The material for the investigations reported in this note consists of a population of 693 seedlings obtained from this cross (called hereafter HC series). These were tested in the following years for tolerance to high thermoperiods, drought and resistance to charcoal rot and root-knot nematodes. The results of observations for each of these are presented below:

Tolerance to high thermoperiod—The material was tested as described earlier and segregated as follows:

Highly tolerant	..	..	..	160
Tolerant	..	..	..	123
Moderately tolerant	..	..	..	138
Susceptible	..	..	..	272
TOTAL				693

Tolerance to Drought—The population was tested as described above and segregated as follows:

Highly tolerant	..	..	..	41
Tolerant	..	..	..	150
Moderately tolerant	..	..	..	51
Susceptible	..	..	..	451
TOTAL				693

Nematode Resistance—The entire population was grown in a field highly infested with the root-knot nematode. Of these, 19 selections did not show any infestation. These were further tested under laboratory conditions for resistance and two cultures, viz., HC 294 and HC 115

were found to show high degree of resistance to root-knot nematode.

Charcoal Rot Resistance—For initial screening, the material was grown at Patna in the field highly infested with charcoal rot. Later, the entire population was screened for resistance under laboratory conditions. Seven of these selections, viz., HC 24, HC 246, HC 671, HC 716, HC 1031, HC 1239 and HC 1294 showed high degree of resistance to charcoal rot.

Frost Resistance—It was felt necessary to have such varieties which could stand frost and drought conditions and so the entire HC series was tested under natural frost conditions at Simla, keeping Kufri Red (susceptible to frost) as control. The following results were obtained:

Highly resistant	..	..	..	8
Resistant	..	..	..	11
Moderately resistant	..	..	..	26
Susceptible	..	..	..	648
TOTAL				693

Multiple Resistance—Of the 693 selections, a few possessed multiple resistance (Table I). HC 294 and HC 115 were tolerant to heat, drought and frost and resistant to root-knot nematode. Besides, three other HC selections, viz., HC 731, HC 1239 and HC 1266 yielded more than 750 gm. per plant (as against controls—Up-to-Date = 600 gm, Kufri Red = 500 gm. and Kufri Safed = 300 gm.) under high temperature conditions at Patna.

The above data indicate that HC series constitutes a wealth of material from which clones possessing different attributes could be

selected as parental material for different breeding projects. The material having one or more characters is, therefore, being crossed amongst themselves as well as with the commercial varieties to incorporate the desired characteristics in high-yielding types adapted to different agro-climatic tracts.

ACKNOWLEDGEMENT

Thanks are due to the Botany staff at Simla and Patna, Dr. K. D. Paharia and Dr. S. K. Bhattacharya for conducting laboratory tests for charcoal rot and Dr. K. K. Nirula for nematode resistance.

Central Potato Res. Institute, M. L. KHANNA.
Simla, March 22, 1966.

1. Khanna, M. L., "Breeding potato varieties tolerant to higher thermoperiods," *Curr. Sci.*, 1966, **35** (6), 143.

AN ANALYSIS OF SOME PARTIALLY STERILE INDIVIDUALS IN A POPULATION OF *AGERATUM* *CONYZOIDES* LINN. AND *A. HOUSTONIANUM* MILL.

THIS article presents evidence of hybridization in nature between *Ageratum conyzoides* Linn. and *A. Houstonianum* Mill. based on sterility and somewhat intermediate morphological traits of some individuals in a mixed population found in a small orchard of guava and mango in Patna. The two species differ in a number of characters. Seven of them, which could be conveniently scored in the field, were used in this study (Table I) evaluating each trait subjectively

each plant gave a crude index of its resemblance. Plants with index values 0-3 were assigned to *A. Houstonianum* and those with 11-14 to *A. conyzoides*, while still others with 6-10 could be assigned to neither. They were intermediate in appearance, although with more of *A. conyzoides* elements. They were not in anyway variants of *A. conyzoides* as was evident from a similar analysis of a pure population of the species (index values 10-14). Moreover, these intermediates were pollen as well as seed-sterile to some extent. All these suggest that they were of hybrid origin.

The hybridization seems to have occurred under an unusual circumstance. The chromosome number of $n=20$ for the putative hybrids and that of $n=10$ and 20 for *A. Houstonianum* and *A. conyzoides* respectively in the locality indicate a probable fusion between an unreduced gamete of *A. Houstonianum* and a normal one of *A. conyzoides*. This at once explains why the hybrid derivatives should look more like *A. conyzoides*, because further back-crosses with this species are more likely to occur. Back-crosses with *A. Houstonianum* could have occurred only when unreduced gametes of this species were frequently produced. In the absence of hybrid derivatives of $2n=30$ or other varying chromosome numbers, one would like to infer that back-crosses with *A. Houstonianum* have apparently failed under normal conditions. Such instances of hybridization between two closely related species, but at two ploidy levels, are known² and have been considered important factors in evolution adding variability to species by introgression.

TABLE I

Characters used to score the population of *A. Houstonianum*, *A. conyzoides* and their hybrid derivatives

Trait	<i>Houstonianum</i> -like (0)	Intermediate (1)	<i>Conyzoides</i> -like (2)
1. Capitulum-diameter (freshly open)	0.5-0.6 cm.	c. 0.5 cm.	0.4-0.5 cm.
2. Involucral bracts	.. Linear	± lanceolate	Oblong-lanceolate acuminate
3. Whitish margin of invol. bracts	.. Absent	Comparatively narrower	Present
4. Back of the involucral bracts	.. Densely hairy	Sparsely hairy	Rarely to sparsely hairy
5. Style length	.. 1-1.3 cm.	0.8-0.9 cm.	0.6-0.9 cm.
6. Leaf-base	.. Deeply cordate	± cordate	Faintly cordate to entire to tapering
7. Leaf-length/width ratio	.. 0.8-1.4	1-1.4	1.2-1.8

following Anderson.¹ A value of 0 was assigned when the trait was like *A. Houstonianum*, 2 when like *A. conyzoides*, and 1 when intermediate. The total values thus obtained for

The authors wish to thank Prof. R. P. Roy for his encouragement, and Shri Sukhlal Mahto, the owner of the orchard, for permission to carry out the work.

Department of Botany,
Patna University, Patna-5,
February 25, 1966.

V. THAKUR.
G. K. THAKUR.

1. Anderson, E., *Introgressive Hybridization*, Wiley, N.Y., 1949, pp. 109.
2. Stebbins, G. L., Jr., *Variation and Evolution in Plants*, N.Y., 1950.

CHROMOSOMES OF *SCHISTOCERCA GREGARIA* (FORSKAL)

THE spermatogonial complements of *Schistocerca gregaria* show that the diploid chromosome number in $2n = 23$ in the male (Figs. 1 a and 1 b).



FIGS. 1 a and b. Spermatogonial metaphase chromosomes of *S. gregaria*. $\times 842$.

All the chromosomes are acrocentric. White¹ has characterized the chromosome complement of this insect, excluding the sex chromosome, as three long, five medium and three short. This observation, however, is not based on actual measurement of chromosomes. John and Naylor² have measured the spermatogonial metaphase chromosomes of *S. gregaria* and have corroborated White's observation. According to their measurement, the X-chromosome is the second largest in the complement. Thus according to them there are four long chromosomes. Their measurements of pachytene chromosomes agree fairly well with measurements of second division metaphase chromosomes done by the author. Csik and Koller³ in their diagram label the X-chromosome as the longest in the complement. The measurements of chromosomes obtained from ten second division meiotic metaphase plates in the present material indicate that there are two pairs of very small and a single pair very large. The sex chromosome is one of the medium sized ones.

The general course of meiosis is the same as in other species of grasshoppers. Chiasmata are partly localized (White,¹ Henderson⁴). The mean chiasma frequency per nucleus is 17.11 ± 0.41 at diplotene, 13.14 ± 0.34 at diakinesis and 13.22 ± 0.33 at metaphase 1.

There is a statistically significant reduction of chiasmata from diplotene to diakinesis (difference = 3.97; $t = 5.69$; $P < .001$). But between diakinesis and metaphase 1, no significant loss of chiasmata occurs. Terminalization data for the whole nuclei indicate that there is a significant increase of total terminal chiasmata between diplotene and diakinesis, whereas between diakinesis and metaphase 1 no significant increase takes place. White¹ has stated "In all three species there is some terminalization of chiasmata, but it is fairly clear that there is no significant reduction in their number between diplotene and metaphase, due to terminalization".

The author wishes to acknowledge his gratitude to Professor B. R. Seshachar for giving necessary facilities to carry out this investigation. His sincere thanks are due to Dr. S. Pradhan, Entomology Division, Indian Agricultural Research Institute, New Delhi, for supplying specimens.

Department of Zoology,
University of Delhi, Delhi-7,
August 6, 1966.

M. K. DUTT.

1. White, M. J. D., *J. Genet.*, 1934, 29, 203.
2. John, B. and Naylor, B., *Heredity*, 1961, 16, 187.
3. Csik, L. and Koller, P. C., *Chromosoma*, 1939, 1, 191.
4. Henderson, S. A., *Ibid.*, 1962, 13, 437.

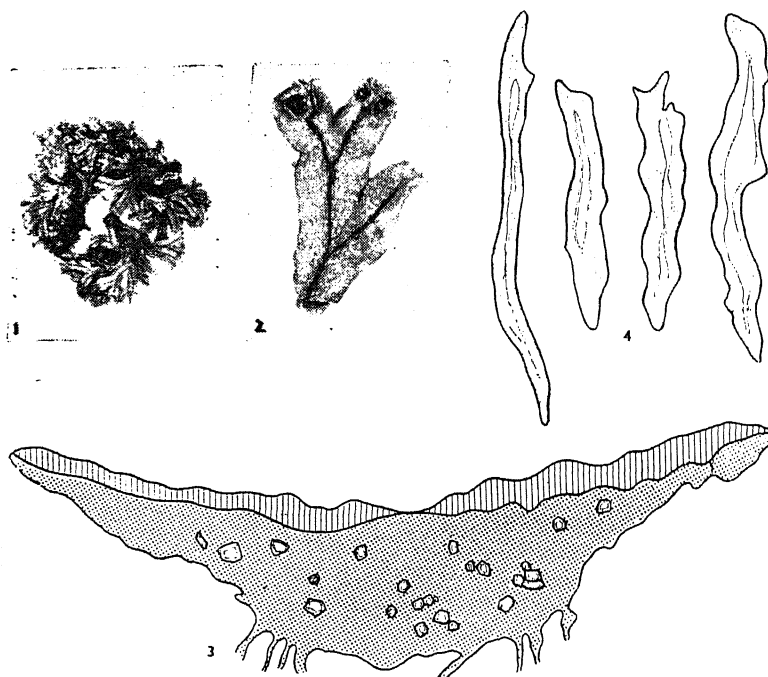
OCCURRENCE OF *MARCHANTIA* AT SRIRANGAPATTANA, MYSORE STATE

Marchantia is a well-known genus of Marchantiales. It is cosmopolitan with about 65 species. About eleven species have been reported from India (1943)¹ growing mainly on the Himalayas. In South India *Marchantia* has so far been reported on the hills of Kodakanal and Ootacamund.

The species under report occurs along the banks of the river Cauvery at Srirangapattana, about nine miles from Mysore City, at an altitude of about 2000 ft., above sea-level. This is the first time that *Marchantia* is being reported growing naturally at such a low altitude and in Mysore State. The gametophytic body is a thallus which is prostrate, flat and dorsiventral. It branches dichotomously and on account of repeated dichotomy it often takes the rosette form (Fig. 1).

The mature thallus which attains a length of about two to three centimeters has a dorsiventral differentiation. There is a prominent midrib on the dorsal side and along the midrib gemma cups are present, each gemma cup containing a large number of special vegetative reproductive bodies—the gemmæ (Fig. 2). On the

Marchantia is a long-day plant. Archegoniophores and antheridiophores have been induced in *M. polymorpha* under green-house conditions by Anthony (1962),² by subjecting the plants to proper photoperiod and temperature conditions. Similar experiments to induce archegoniophores and antheridiophores in the



FIGS 1-4. Fig. 1. Photograph of *Marchantia* to show the habit. Fig. 2. Photograph of the thallus of *Marchantia* showing the gemma cups. Fig. 3. Transverse section of the thallus indicating the sclereids, $\times 40$. Fig. 4. Fibre-like sclereids. $\times 100$.

ventral side there are numerous rhizoids and scales. The rhizoids are of two types, smooth and tuberculate. The scales are multicellular and one-celled in thickness. There are two rows of scales on each side of the midrib. Under natural conditions the plants do not bear either antheridiophores or archegoniophores.

A vertical cross-section of the thallus shows the usual anatomical details. But the ventral tissue underlying the air chambers shows a number of fibre-like sclereids scattered among the parenchymatous cells (Figs. 3 and 4).

present species are in progress. A detailed description of the plant and the experiments will be published elsewhere.

Department of Botany,
Central College,
Bangalore, September 9, 1966.

M. NAGARAJ.

1. Chopra, R. S., "A census of Indian Hepatics," *Jour. Ind. Bot. Soc.*, 1943, **23**, 237.
2. Robert, E. Anthony, "Green-house culture of *Marchantia polymorpha* and induction of sexual reproductive structures," *Turtlox*, 1962, **40**, 2.

REVIEWS AND NOTICES OF BOOKS

Vibrations, Waves and Diffraction. By H. J. J. Braddick. (McGraw-Hill Publishing Company Limited, London), 1965. Pp. viii + 217. Price 36.

Phenomena which repeat periodically and waves of many kinds make up a good deal of physics, and this text-book emphasises the strong common line of thought running through such topics as sound, optics, or electronic circuits, touching also on electro-magnetism and quantum mechanics.

While the treatment is largely theoretical, mathematics arguments are used as tools to achieve physical understanding, and the average university entrant will not be held back by lack of a particular piece of mathematical lore. Fourier methods occupy a central position, a unique feature being emphasis on their physical application. Other important features are the avoidance of topics of purely conventional interest, and a modern treatment of diffraction, applicable both to optical and X-ray phenomena.

The titles of the chapters contained in this book are listed below: 1. Harmonic Oscillators; 2. Forced Oscillations; 3. Waves; 4. Fourier Analysis; 5. Dispersive Media and Group Velocity; 6. Stationary Wave Patterns; 7. Reflection; and 8. Huygens' Principle and Diffraction.

C. V. R.

1. **Enzyme and Metabolic Inhibitors (Vol. II).** By J. Leyden Webb. (Academic Press, New York and London), 1966. Pp. xx + 1237. Price \$ 34.00.
2. **Enzyme and Metabolic Inhibitors (Vol. III).** By J. Leyden Webb. (Academic Press, New York and London), 1966. Pp. xx + 1028. Price \$ 32.00.

Volumes II and III of this treatise cover, in detail, groups of metabolic inhibitors that exhibit certain effects due to their structural relations to naturally occurring substances or their reactions with sulfhydryl groups on enzymes. The fundamental principles discussed in Volume I are comprehensively illustrated and applied to these specific groups of inhibitors. The actions of the inhibitors at the enzyme level are correlated with their effects on metabolism of living cells and their effects on the functions of tissues:

Volume II deals with the following sections: Malonate; Analogs of Enzyme Reaction Com-

ponents; Dehydroacetate; Sulfhydryl Reagents; Oxidants; o-Iodosobenzoate; Mercurials.

Volume III deals with the following sections: Iodoacetate and Iodoacetamide; Malate; N-Ethylmaleimide; Alloxan; Quinones; Arsenicals; Comparison of SH Reagents.

C. V. R.

Advances in Radiation Biology (Vol. 2). Edited by Leroy G. Augenstein, Ronald Mason, and M. R. Zelle. (Academic Press, New York and London), 1966. Pp. x + 371. Price \$ 15.00.

The articles in the current volume cover a spectrum of topics reflecting the interdisciplinary approach to research in radiation biology. Presentations range from critical reviews and the systematization of available data to theoretical evaluations which point the way to future progress in a particular topic. These different approaches will be of value to both the student and the researcher working in radiation biology.

This volume includes: 1. Reactivation after Photobiological Damage, by Claud S. Rupert and Walter Harm; 2. The Study of Labile States of Biological Molecules with Flash Photolysis, by Leonard I. Grossweiner; 3. Repair of Premutational Damage, by R. F. Kimball; 4. The Genetic Control of Radiation Sensitivity in Micro-organisms, by Howard I. Adler; 5. A Physical Approach to the Visual Receptor Process, by Barnett Rosenberg; 6. The Role of Genetic Damage in Radiation-Induced Cell Lethality, by D. R. Davies and H. J. Evans.

C. V. R.

Annual Review of Medicine (Vol. 17). Edited by Arthur C. De Graff and William P. Creger, Associate Editor. (Annual Reviews, Inc., 231, Grant Avenue, Palo Alto, California, U.S.A.), 1966. Pp. 563. Price \$ 8.50 (U.S.A.) and \$ 9.00 (elsewhere).

Volume 17 of this well-known series contains the following chapters: Current Aspects of the Structure, Function and Genetics of the Immunoglobulins, by D. Gitlin; Immunochemical Mechanisms of Drug Allergy, by B. B. Levine; Principles of Active Immunization, by G. Edsall; Amyloidosis and Plasma Cell Disorders, by H. A. Azar; Polymyositis, by C. M. Pearson; Newer Aspects of Diabetic Microangiopathy, by J. Berkan and H. Rifkin; The Juxtaglomerular Complex, by P. M. Hartroft; Thyroid-Cate-

choline Interrelations, by S. S. Waldstein; Amino-aciduria, by W. L. Nyhan and P. Tocci; Familial Carbohydrate Intolerance and Hypoglycemia, by M. Cornblath; Radiotherapy for Malignant Lymphomas, by E. C. Easson; Effect of Electrolyte Disturbance on the Central Nervous System, by R. Katzman; Some Aspects of Perinatal Pharmacology, by S. J. Yaffe; Glaucoms, by B. Becker and N. Ballin; Granulomatous Diseases of the Gastrointestinal Tract, by D. H. Present, A. E. Lindner, and H. D. Janowitz; Hepatic Aspects of Bilirubin Metabolism, by I. M. Arias; Platelet Stickiness, by J. R. O'Brien; The Prevention of Rh Hemolytic Disease, by R. B. McConnell; Chemistry, Distribution, and Function of Blood Group Substances, by A. E. Szulman; Relation of Abnormal Proteins to Formed Elements of Blood: Effects Upon Erythrocytes, Leukocytes, and Platelets, by W. C. Levin and S. E. Ritzmann; Viral-Induced Bacterial Toxin, by J. B. Zabriskie; Unclassified Mycobacterial Diseases, by W. Lester; Rhinoviruses and Common Colds, by C. H. Andrews; Mycoplasma Pneumonic, by B. R. Forsyth and R. M. Chanock; Asymptomatic Bacteriuria, by C. M. Kunin; Biochemical and Genetic Aspects of Mental Retardation, by J. H. Menkes and B. R. Megeon; The Pulmonary Veins, by A. L. Hyman; Electrical Control of Cardiac Rhythm, by T. Killip, III, and C. T. Lambrew; Mechanical Devices to Assist or Replace the Failing Heart, by B. Eiseman, F. C. Spencer, and W. G. Malett; Physiologic Basis of Prolonged Artificial Ventilation, by G. Fletcher and J. P. Bunker; Adrenergic Blocking Agents in the Treatment of Shock, by J. H. Bloch, C. H. Pierce, and R. C. Lillehei. C. V. R.

Annual Review of Physiology (Vol. 28).

Edited by Victor E. Hall. (Annual Reviews, Inc., 231, Grant Avenue, Palo Alto, California, U.S.A.), 1966. Pp. vii + 571. Price \$8.50 per copy (U.S.A.) and \$9.00 (elsewhere).

The contents of this volume are as follows: Prefatory Chapter: From The Spinal Co-ordination of Movements to the Psychoneural Integration of Behaviour, by J. S. Beritashvili (Beritoff); Functions of Lysosomes, by Christian de Duve and Robert Wattiaux; Connective and Supporting Tissues: Mucopolysaccharides of Connective Tissues, by Sara Schiller; The Physiology of the Skin, by Brian Potter; Muscle, by D. R. Wilkie; Respiration, by Solbert Permutt; Gastrointestinal Absorption, by John A. Benson, Jr., and Alfred J. Rampone; Systemic Circulation, by Merrill P.

Spencer; Heart, by Eugene Braunwald; Homeostatic Regulatory Mechanisms of Hematopoiesis, by Dane R. Boggs; Statistical Analysis and Functional Interpretation of Neuronal Spike Date, by George P. Moore, Donald H. Perkel, and Jose P. Segundo; Mathematical Models and Computer Analysis of the Function of the Central Nervous System, by W. Ross Ashby; Comparative Physiology: Learning in Invertebrates, by James V. McConnell; Olfaction, by Bernice M. Wenzel and Michael H. Sieck; Adenohypophysis: Prolactin, by Joseph Meites and Charles S. Nicoll; Insulin and the Pancreas, by Gerold M. Grodsky and Peter H. Forsham; Some Aspects of Reproductive Physiology, by Charles W. Lloyd and Judith Weisz. C. V. R.

Vitamins and Hormones (Vol. 23)—*Advances in Research and Applications*. Edited by R. S. Harris, I. G. Wool and J. A. Loraine. (Academic Press, New York and London), 1966. Pp. xi + 424 Price \$14.00.

The scope of this volume is indicated by the titles of the articles and their respective contributors listed below: Adrenal Steroids and Carbohydrate Metabolism, by Bernard R. Landau; Hormone Antibodies in Endocrinology, by Peter H. Wright; The Regulation of the Synthesis and Release of ACTH, by Joan Vernikos-Danellis; Secretion of Steroid Hormones *in vivo*, by Kristen B. Eik-Nes and Peter F. Hall; Interrelations between Progesterone and the Ovary, Pituitary, and Central Nervous System in the Control of Ovulation and the Regulation of Progesterone Secretion, by Irving Rothchild; Hormone Assays in Human Breast Cancer, by R. D. Bulbrook; Biologically Active Substances in Royal Jelly, by Heinz Rembold. C. V. R.

Modern Technical Physics. By A. Beiser. (Addison Wesley Publishing Company, Inc., 10-15, Chitty Street, London, W. 1), 1966. Pp. 706. Price 53 sh.

The book has been designed for a two-semester introductory course in Physics to beginning students entering technical schools. In Indian Universities it can be recommended as a supplementary text-book for self-study to students of Pre-university classes and first year of technological institutes. The treatment emphasises aspects of importance in technology. There are a number of worked examples, and hundreds of problems for the student to try his own hand. The last six chapters of the

book (about 100 pages) are devoted to modern physics and introduce the student to elementary ideas of relativity and quanta, atoms and atomic chemistry, solid state, nucleus, and nuclear transformations. A. S. G.

Introduction to Electronics. By V. A. Suprynowicz. (Addison Wesley Publishing, Co., Inc., 10-15, Chitty Street, London W. 1). Pp. 324. Price \$ 9.50.

This is an ideal book to understand the basic principles of electronics and the applications of electronic instruments in many fields of research. The presentation is such that it is best fitted for self-study also. Although the extension of the title says "for students of biology, chemistry, and medicine", the book is sure to appeal to a much larger section of scientists connected with disciplines where electronic instruments are used. A. S. G.

Semiconductor Devices. By J. J. Brophy. (Published by George Allen and Unwin Ltd., Ruskin House, 40, Museum Street, London W.C. 1), 1966. Pp. 130. Price 18 sh. net.

The study of semiconductor electronics and semiconductor devices has received significant attention in recent years, especially because of their wide commercial applications. These applications, notably the transistor, have brought the subject within the sphere of interest of even the ordinary intelligent layman. Here is a book which will satisfy his curiosity without invoking too much background knowledge on his part of a mathematical or technical nature. The book explains with a number of illustrations, the operation, structure, and characteristics of most important semiconductor devices. The book is extremely readable, scientifically accurate and is sure to appeal to the general reader. In the hands of a beginning student of science and technology it will stimulate further study and experiments on the subject. A. S. G.

College Chemistry. By B. H. Mahan. (Addison Wesley Publishing Company, Inc., 10-15, Chitty Street, London W. 1), 1966. Pp. 666. Price 72 sh.

Prof. Mahan's earlier text-book *University Chemistry* has been having a good reception by students and teachers of general chemistry in colleges. The present publication is intended to meet a special need, namely the requirements of those students who have not undergone a course of elementary calculus. Accordingly

the bulk of the material and classification of chapters remain the same, only the presentation has been suitably altered to avoid manipulation of calculus.

The first four chapters are devoted to macroscopic properties of matter, the next five chapters deal with characterisation of chemical reactions and systems, including chemical equilibrium, chemical thermodynamics and chemical kinetics. Then come the two chapters on electronic structure of the atoms and the chemical bond. The next four chapters contain descriptive material of inorganic chemistry treated according to periodic properties. Then comes the chapter on organic chemistry, and finally the one on the nucleus. A. S. G.

Plant Pathology—An Outline Manual. By A. N. Sudarsan Rao. (Published by the Author, Agricultural College, Hebbal, Bangalore-24). Pp. 62. Price Rs. 2-50.

Experience of teaching to undergraduate students of agriculture on plant pathology must have prompted the author to put in print his carefully collected information and lecture notes on the subject, for the benefit of a wider audience. The data have been systematically classified and shown in tabular form. Inexpensively printed and produced, the booklet will be a useful hand-book for ready reference and revision study to students of microbiology and plant pathology. A. S. G.

Books Received

Progress in Experimental Personality Research. Edited by B. A. Maher. (Academic Press, New York), 1966. Pp. x + 331. Price \$ 9.50.

Processes of Organic Evolution. By G. L. Stebbing. (Prentice-Hall Inc., Englewood, Cliffs, New Jersey), 1966. Pp. xii + 191. Price not given.

Poisonous Plants of India. By R. N. Chopra, R. L. Badhwar and S. Ghosh. (Published by Indian Council of Agriculture Research, New Delhi). Vol. I: Pp. xx + 631. Price Rs. 32; Vol. II: Pp. 632-972. Price Rs. 20.

Essentials of Palynology. By P. K. K. Nair. (Asia Publishing House, Calicut Street, Ballard Estate, Bombay-1), 1966. Pp. vii + 96. Price Rs. 9.

Development of Irrigation in India. (Central Board of Irrigation and Power, Curzon Road, New Delhi-1), 1965. Pp. x + 231.

Irrigation Research in India. By D. V. Joglekar. (Central Board of Irrigation and Power, New Delhi-1), 1965. Pp. vi + 159.

Tempo

N.T.C. RESISTORS (Thermistors)
Beads, Pellets & Glass Probes

CERAMIC MAGNETS
Cylindrical & Bar Types

For further details contact :

ELE Department,
TEMPO INDUSTRIAL CORPORATION
Engg. Divn. of Primco (P.) Ltd.
394, Lamington Rd., Bombay-4, BR.
PHONE : 358033

PHONE : 55-8070

CABLE ADDRESS: "SINTERED"



IMPORTERS & MANUFACTURERS OF
SCIENTIFIC GLASS APPARATUS & SINTERED GLASSWARES
11, ULTADANGA ROAD, CALCUTTA-4

made from Pyrex Glass

Specialists in

- Sintered Glasswares
- Chemical Apparatus
- Gas Analysis Apparatus
- Volumetric Glasswares



GOOCH
CRUCIBLE

OVER TWENTY YEARS' PROVED PERFORMANCE

(INDIA MADE)

X'RAY DIFFRACTION APPARATUS
Complete with

MACHLETT SHOCKPROOF BERYLLIUM WINDOW SEALED TUBES OF
DIFFERENT TARGET MATERIALS
SINGLE VALVE HALF-WAVE RECTIFIED OR TWO-VALVE
FULL-WAVE RECTIFIED

MACHINE already incorporates voltage compensator to compensate plus or minus 15 volts supply change.

Electro-Magnetic, Electronic, Servo-Mechanical or Chemo-Electric STABILISER can be added to the filament circuit or to the entire MACHINE for further STABILISATION.

CAMERAS OF VARIOUS TYPES CAN ALSO BE SUPPLIED
FOR THE MACHINE

Also

X'RAY PLANT FOR BIOLOGICAL RESEARCH & INDUSTRIAL RADIOGRAPHY
AND HIGH TENSION TESTING SETS.

DELIVERY EX-STOCK—NO LICENCE REQUIRED

Further details from :—

RADON HOUSE P. LTD.
No. 7, Sardar Sankar Road, CALCUTTA-26

PECTIN TRANS-ELIMINASE

A. D. AGATE, N. P. JAYASANKAR AND J. V. BHAT

Fermentation Technology Laboratory, Indian Institute of Science, Bangalore-12

EVER SINCE the discovery of pectin by Vanquelin in 1790,¹ pectic substances have interested both the 'pure' scientist as well as the technologist. The pectic substances are carbohydrate derivatives of plant origin. They are complex and colloidal in nature and mostly comprise of anhydrogalacturonic acid units linked together in $\alpha(1-4)$ glycosidic linkage to form a chain-like structure of polygalacturonic acid units. While it is true that D-galacturonic acid is the main constituent of pectin, most natural pectins contain about 12% ester methoxyl. A hypothetical pectin with 75% of its carboxyl groups esterified and polygalacturonic acid are depicted in Fig. 1.

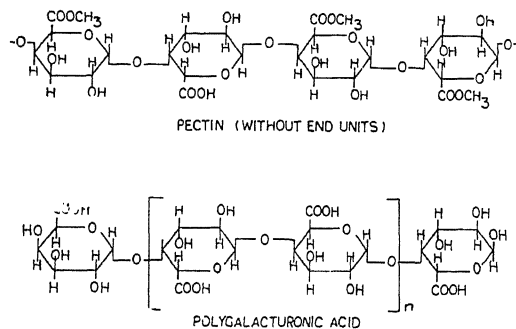


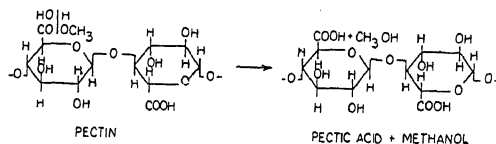
FIG. 1. The Pectic Substances

The complex nature of molecules comprising these substances has not only caused the confusion in their chemistry but has been mainly responsible for the delay in the accumulation of knowledge pertaining to those enzymes which have the power to break these molecules down. However, the immense importance of pectic substances and their enzymes has helped to maintain the tempo of work thereon and it is the purpose of this review to briefly trace the literature on pectic enzymes in general and to discuss in detail what has recently been the subject of a new discovery, *viz.*, pectin *trans*-eliminase.

Until 1960, the well described pectinolytic enzymes produced by micro-organisms were all thought to be hydrolytic in nature.² The enzyme polygalacturonase (PG) facilitates the hydrolysis of $\alpha(1-4)$ glycosidic linkages in the polygalacturonic acid skeleton of pectic or pectinic acids with the resulting formation of polygalacturonic acids of small molecular sizes and of monogalacturonic acid. Pectic acid depolymerase (DP) differs from PG in having a sharp pH optimum at 4.5 and to get activated

by sodium chloride. Pectin methyl esterase (PME) catalyses the cleavage of methyl ester groups in pectinic acids and pectins to yield pectic acids and methanol. The mode of action of PG and PME on macromolecular pectin is illustrated in Fig. 2.

ACTION OF METHYLESTERASE



ACTION OF POLYGALACTURONASE

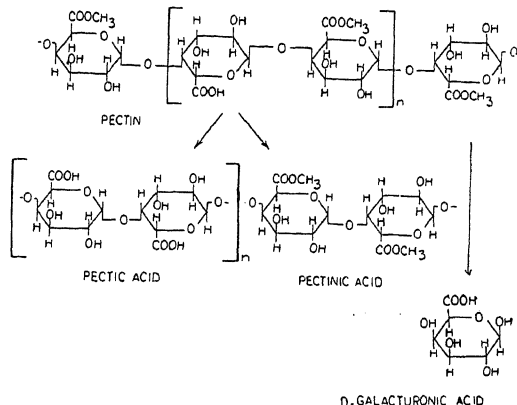


FIG. 2. Action of PG and PME

Investigations on the alkaline degradation of pectin by Neukom and Deuel³ led to the discovery of the new pectinolytic enzyme pectin *trans*-eliminase. The mechanism of this degradation was explained on the lines of " β -dealkoxylation" according to which, the removal of activated hydrogen at C-5 resulted in the formation of a double bond between C₄ and C₅ and the cleavage in β -position to the ester carbonyl group. Subsequently, Albersheim, Neukom and Deuel⁴ observed that such a '*trans*-elimination' also took place on heating pectin in a buffer solution at pH 6.8. The products of degradation showed an absorption maximum at 230-235 m μ , reacted with thiobarbituric acid to give a coloured product having an absorption maximum at 547 m μ and formed oxalic acid with ozone. These characteristics provided additional evidence for a *trans*-elimination reaction consequent to the removal of H atom at C-5, formation of a double bond between C-4 and C-5, and elimination of glycosidic residue at C-4. Later, Albersheim, Neukom and Deuel⁵ demonstrated the presence, in commercial

pectinase preparation, "Pectasin-R-10", of an enzyme that brought about such a *trans*-elimination reaction and designated it as pectin *trans*-eliminase. The purification of this enzyme was achieved by Albersheim and Killias⁶; they also described its properties. Subsequently, Albersheim was able to obtain it in a crystalline form.⁷ According to the substrate specificity exhibited, these enzymes have been now designated pectin *trans*-eliminase (PTE) or polygalacturonic acid *trans*-eliminase (PATE) (Fig. 3). The product of this reaction has been fully characterised by Hasegawa and Nagel⁸ as 4-O- α -D-(4, 5-dehydrogalacturonosyl)-D-galacturonic acid (Fig. 4).

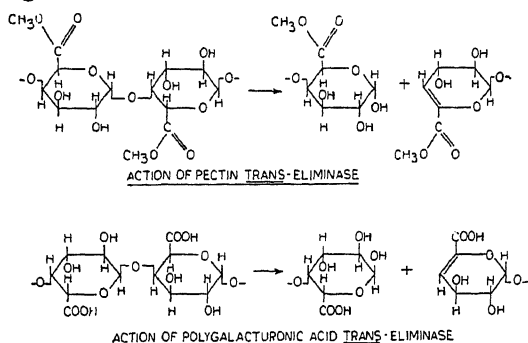


FIG. 3. *Trans*-Eliminase Enzymes

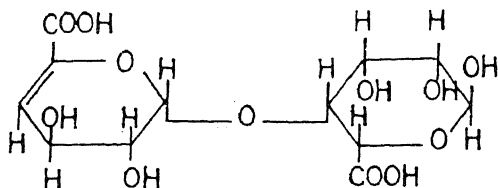


FIG. 4. Structure of Dimer

It has now become apparent that a number of microbes may be producing *trans*-eliminases and it is reasonable to assume that many of the polygalacturonases described prior to 1960 (before the discovery of PTE by the Swiss group of workers) may have to be recharacterized.⁹ The polymethyl galacturonase from commercial pectinase—"Hydrolase"—described by Seegmiller and Jansen¹⁰ and pectin depolymerase from *Neurospora crassa* described by Roboz, Barratt and Tatum¹¹ are cases in point.

Since the discovery of the enzyme *trans*-eliminase, the principal mechanism involved in bacterial degradation has been shown to be due to the *trans*-eliminative cleavage of glycosidic linkages. While investigating the pectic enzymes of *Bacillus polymyxa*, Nagel¹² observed an altered digalacturonic acid differing from the normal compound. The factors affecting growth and enzyme secretion by this organism

have since been studied elaborately by Nagel and Vaughn¹³⁻¹⁵ and the *trans*-eliminative mechanism was shown to occur in bacterial degradation of pectic substances. Starr and Moran,¹⁶⁻¹⁷ working on the enzymes of the phytopathogenic soft rot bacteria as *Erwinia* and *Bacillus*, recorded results substantiating these findings. Starr and Nasuno¹⁸ subsequently indicated the presence of an extracellular enzyme in *Xanthomonas* sp. which has a specific action on polygalacturonic acid rather than pectin.

Recent work carried out in this laboratory on the culture filtrates of some bacteria characterized as *Xanthomonas*, the enzyme PTE/PATE was not detected.¹⁹⁻²⁰ However, data obtained seem to suggest that these cultures, in addition to PG, possess a hitherto unrecognized mode of action on pectic substances, since all the breakdown products could not quantitatively account for those that might have resulted from the action of PG alone. The enzyme PME was not detected in their system. On the other hand, the enzyme *trans*-eliminase has been demonstrated in bacterial cultures of *Corynebacterium barkeri*,²¹ *Flavobacterium* sp.,²¹ *Micrococcus* sp.,²²⁻²³ and *Arthrobacter* sp.²⁴ Preiss and Ashwell²⁵ reported the presence of this enzyme in *Pseudomonas* sp. and Hsu and Vaughn²⁶ in *Aeromonas liquefaciens*. Recently, Nagel and Anderson²⁷ studied the action of the enzymes of *Bacillus polymyxa* on normal and unsaturated oligogalacturonic acids while Dave and Vaughn²⁸ gave evidence to indicate that, in contrast to other polygalacturonic acid *trans*-eliminases studied, the PATE of *Bacillus pumilus* produced a large quantity of unsaturated trigalacturonic acid.

MacMillan and Vaughn²⁹ have discovered yet another bacterial polygalacturonic acid *trans*-eliminase in a strain of *Clostridium multifementans*; the enzyme attacked the terminal groups to produce a preponderance of unsaturated digalacturonic acid. The organism was also reported to produce the demethylating enzyme so that, grown *in vitro* or in nature, the cultures can bring about the degradation of pectin as far as the dimer stage. However, it appears to be unable to produce the digalacturonase; in other words, it is unlike *B. polymyxa*¹² in so far as it does not destroy completely the pectic material, though it may share several other properties with it. Such a terminally acting PATE was also observed in certain *Erwinia* sp. by Okamoto and Ozawa.³⁰

The presence of the enzyme PTE in different species of the mould *Aspergillus* was demonstrated by Edstrom and Phaff.³¹ These authors purified the enzyme PTE from the culture fluid of *Aspergillus fonsecæus* and demonstrated that the enzyme was specific for pectin and differed in several respects from a PATE produced by certain bacteria. The enzyme had an optimum pH at 5.2 and was not absolutely dependent on Ca ions unlike the bacterial trans-eliminases. These authors further provided the course of action by *A. fonsecæus* PTE on pectin and on certain oligogalacturonide methyl esters.³²

That the actinomycetes could be considered as a potent group for the production of pectinolytic enzymes have been proved by the successful investigations in this laboratory.^{33,34} Simultaneously Kaiser³⁵ reported the isolation of pectinolytic actinomycetes by exploitation of the method developed by Wieringa.³⁶ It was demonstrated by Agate²¹ and Agate, Bilimoria and Bhat³⁷ that several species of *Streptomyces* possessed trans-eliminase activity. The streptomycetal trans-eliminase in general resembled the bacterial enzymes, but differed from the fungal trans-eliminase.

A PTE (and PATE) was detected in crude acetone powder prepared from protozoa occurring in the roots of *Calotropis* and *Hibiscus* plant straws.³⁸ Subsequently, it was demonstrated conclusively in the protozoan species *Plagiopyla*.²¹ A PATE, unlike the PTE in *S. viridochromogenes* was demonstrated in an *Epistylis* sp. occurring in sewage and sewage products.³⁹ Later on, two other protozoal species from the same ecosystem, viz., *Vorticella*, *Carchesium* were found to contain this enzyme²¹ and the inclusion of protozoa in the already existing list of micro-organisms producing PTE was a contribution in the field from this laboratory.

Although these interesting trans-eliminases have been found to be produced by bacteria, actinomycetes, moulds and even protozoa, to date in our laboratory we have not been able to detect this enzyme in the large collection of pectinolytic yeasts that we have, including such pectinolytic species as *Cryptococcus laurentii*, *Saccharomyces kluyveri*, *Cryptococcus diffusus*, *Rhodotorula glutinis*, *R. flava*, etc.^{19,21,24} This finds confirmation in the fact that Vaughn also could not detect the presence of any trans-eliminase enzyme in the pectinolytic yeasts, e.g., in *Saccharomyces fragilis* or *Rhodotorula glutinis*.⁹

The discovery of this enzyme has broken new grounds in the field of microbial pectinolytic

enzymes and it is hoped that a better understanding of these enzymes would help to bring a little order into the chaos prevailing in the field of pectin chemistry.

1. Vanquelin, M., *Ann. Chim.* 1790, **5**, 92.
2. Demain, A. L. and Phaff, H. J., *Wallerstein Lab. Comm.*, 1957, **20**, 110.
3. Neukom, H. and Deuel, H., *Chem. Ind.*, 1958, p. 683.
4. Albersheim, P., Neukom, H. and Deuel, H., *Arch. Biochem. Biophys.*, 1960, **90**, 46.
5. —, — and —, *Helv. Chim. Acta*, 1960, **43**, 1422.
6. — and Killias, U., *Arch. Biochem. Biophys.*, 1962, **97**, 107.
7. —, *Plant Physiol.*, Supplement XXXIX, 1961.
8. Hasegawa, S. and Nagel, C. W., *J. Biol. Chem.*, 1962, **237**, 619.
9. Vaughn, R. H., *Microbiological Quality of Foods*, Academic Press, New York, 1963.
10. Seegmiller, C. G. and Jansen, E. F., *J. Biol. Chem.*, 1952, **195**, 327.
11. Roboz, E., Barratt, R. W. and Tatum, E. L., *Ibid.*, 1952, **195**, 459.
12. Nagel, C. W., *Ph.D. Dissertation*, University of California, Davis, 1960.
13. — and Vaughn, R. H., *Arch. Biochem. Biophys.*, 1961, **93**, 244.
14. — and —, *Ibid.*, 1961, **94**, 328.
15. — and —, *J. Bacteriol.*, 1962, **83**, 1.
16. Starr, M. P. and Moran, F., *Bacteriol. Proc.*, 1961, p. 169.
17. — and —, *Science*, 1962, **135**, 920.
18. — and Nasuno, S., *Bacteriol. Proc. Abstr.*, 1963, p. 116.
19. Bilimoria, M. H., *Ph.D. Thesis*, Indian Institute of Science, Bangalore, 1962.
20. —, *J. Indian Inst. Sci.*, 1966, **48**, 53.
21. Agate, A. D., *Ph.D. Thesis*, Indian Institute of Science, Bangalore, 1965.
22. Jayasankar, N. P. and Bhat, J. V., *Curr. Sci.*, 1964, **33**, 369.
23. —, Agate, A. D. and Bhat, J. V., *J. Ind. Inst. Sci.*, (In press).
24. —, *Ph.D. Thesis*, Under preparation.
25. Preiss, J. and Ashwell, G., *J. Biol. Chem.*, 1963, **238**, 1571.
26. Hsu, E. J. and Vaughn, R. H., *Bacteriol. Proc.*, 1965, p. 11.
27. Nagel, C. W. and Anderson, M. M., *Arch. Biochem. Biophys.*, 1965, **112**, 322.
28. Dave, B. A. and Vaughn, R. H., *Bacteriol. Proc.*, 1966, p. 6.
29. MacMillan, J. D. and Vaughn, R. H., *Biochemistry*, 1964, **3**, 564.
30. Okamoto, K. and Ozawa, J., *Nôgaku Kenkyû*, 1960, **48**, 39.
31. Edstrom, R. D. and Phaff, H. J., *J. Biol. Chem.*, 1964, **239**, 2403.
32. — and —, *Ibid.*, 1964, **239**, 2409.
33. Bilimoria, M. H., *Chemical Process. Design Symposium*, C.S.I.R., India, 1963.
34. — and Bhat, J. V., *Indian Patent*, 1963, **75**, 325.
35. Kaiser, P., *D.Sc. Thesis*, Paris University, 1961.
36. Wieringa, K. T., *Proc. IV Int. Cong. Microbiol.*, Copenhagen.
37. Agate, A. D., Bilimoria, M. H. and Bhat, J. V., *Curr. Sci.*, 1962, **31**, 462.
38. — and Bhat, J. V., *J. Indian Inst. Sci.*, 1963, **45**, 49.
39. — and —, *Curr. Sci.*, 1963, **32**, 459.

**IN VITRO EFFECTS OF GRISEOFULVIN AND SULPHANILAMIDE ON
COCHLIOBOLUS MIYABEANUS ITO ET KURIBAYASHI ***

S. N. S. SRIVASTAVA

Central Potato Research Institute, Simla

SYSTEMIC applications of griseofulvin and sulphanilamide controlled brown spot disease of rice, caused by *Cochliobolus miyabeanus* (Srivastava¹⁵). A knowledge of their effects on the organism *in vitro*, a prerequisite to assess their mode of action, is lacking. Results of some studies in this context are reported below.

A conidial culture of *C. miyabeanus*, kindly supplied by Shri S. Y. Padmanabhan, Mycologist, Central Rice Research Institute, Cuttack, and griseofulvin by Prof. P. W. Brian, University of Glasgow, were used. Sulphanilamide (May and Baker's) was procured locally. The two chemicals were recrystallised from solutions in acetone and ethanol, respectively, before use.

Studies were conducted with 20 ml. each of potato-dextrose agar and Czapek solution in Pyrex glassware at 24 to 30°C. All-Pyrex distilled water and AR grade chemicals were

sterilised separately and aseptically dispensed into the media to give the desired concentrations. One mm. discs from a 4 to 6-day old culture of the fungus on potato-dextrose agar and 0.1 ml. of a fine mycelial suspension prepared from a similar culture on Czapek solution served as inocula. Growth on the agar medium was measured as mean colony diameter recorded at two places at right angles to each other, and on the synthetic medium as dry mat weight.

Spore germination was studied after the methods of American Phytopathological Society² and Prusova,¹¹ *mutatis mutandis*. A suspension of c. 10,000 spores/ml. from a 12 to 15-day old culture on potato-dextrose agar was used. Observations were recorded after 16 hours.

A minimum of three replicates were maintained.

TABLE I
Effect of sulphanilamide and griseofulvin on growth of C. miyabeanus on potato-dextrose agar

Days after inoculation	Sulphanilamide ($\mu\text{g./ml.}$)								
	0	5	25	50	100	250	500	750	1000
2	24.3*	22.0	19.0	16.0	14.7	14.0	12.0	8.0	4.0
4	50.3	46.3	44.3	38.7	32.7	28.0	18.0	12.0	8.0
6	83.7	80.3	73.3	56.0	46.3	42.3	22.3	14.0	10.0

Days after inoculation	Griseofulvin ($\mu\text{g./ml.}$)								
	0	5	25	50	100	250	500	750	1000
2	32.0	23.0	21.0	16.0	14.3	13.3	9.0	7.7	6.3
4	53.0	33.7	32.7	21.7	19.3	17.0	14.3	13.3	12.3
6	73.3	42.3	42.0	25.3	23.0	22.3	17.3	16.3	14.7

* Diameter of colony in mm.

Note: The bars below the figures indicate that the differences between the treatments are not statistically significant at 5% level.

employed in the preparation of media (pH 7; autoclaved at 15 lb., 20 min.). Stock solutions of griseofulvin and sulphanilamide were

GROWTH ON AGAR MEDIUM

Table I shows that both griseofulvin and sulphanilamide reduced the growth of the fungus, the extent of reduction being dependent upon their concentration and the period of

* Part of Ph.D. Thesis, University of M. dras, 1964.

Chemical	Concentration ($\mu\text{g./ml.}$)									
	0	5	50	100	250	500	750	1000	2500	5000
Sulphanilamide ..	1.3	1.0	0.8	0.9	1.2	1.0	0.8	0.8	1.0	1.8
Griseofulvin ..	1.3	4.0	11.0	11.0	12.0	12.0	18.0	19.0	23.0	31.0



FIG. 4. The effect of various concentrations of griseofulvin (1-5) and sulphanilamide (6-10) on germination of conidia of *C. miyabeanus* at the end of 16 hours ($\times 370$) (1, 6—Control; 2, 7—5 $\mu\text{g./ml.}$ griseofulvin and sulphanilamide; 3—50 $\mu\text{g./ml.}$ griseofulvin; 8—100 $\mu\text{g./ml.}$ sulphanilamide; 4, 9—500 $\mu\text{g./ml.}$ griseofulvin and sulphanilamide; 5, 10—5,000 $\mu\text{g./ml.}$ griseofulvin and sulphanilamide).

The present studies show that mycelial growth and spore germination of *C. miyabeanus* are variously affected by both griseofulvin and sulphanilamide. Similar observations have been reported in other cases (Dimond⁶; Horsfall and Rich⁹). Sisler and Cox¹⁴ assigned these differences to greater reserves of vital metabolites in the spores. Amino-acids and *p*-aminobenzoic acid are known to antagonise sulphanilamide (Bliss and Long⁴; Woods¹⁶). The author¹⁵ demonstrated reversal of the inhibitory effects of the drug on the fungus by the vitamin in a synthetic medium. Similarly, α , β -unsaturated ketones, as griseofulvin is, are inhibited by the vitamin (Green and Bielschkowski, 1942 ex Sexton¹³). It would, therefore, be interesting to investigate the metabolic status of the fungus during growth. The lesser toxicity of both compounds, observed in studies with the potato-dextrose agar, could also be due to the presence of such natural antagonists in the medium.

The greater toxicity of griseofulvin to the fungus, as compared to sulphanilamide, is

presumably related to permeability factors. A chemical with a water-lipoid balance on the lipophilic side seems to be preferentially absorbed. The antibiotic molecule possesses a chlorine atom (Grove *et al.*⁷) that increases lipid solubility and hence permeability (Horsfall⁸). It may be more permeable than sulphanilamide, a water-soluble compound.

The observation, that the rate of fungal growth at low concentrations of sulphanilamide on potato-dextrose agar increased with increased incubation, is also interesting. Horsfall⁸ suggested that prolonged periods of association between fungus and fungicides may be necessary to enable the former to overcome the toxic effects of the fungicides. Brian⁵ reported this to be true for *Botrytis allii* in relation to griseofulvin, and Abbot and Grove¹ showed that the antibiotic was degraded on the surface of fungal hyphae. In the case of sulphanilamide, however, acetylation is known in higher plants (Rudd Jones and Wignall¹²), but information seems to be lacking as regards micro-organisms. It appears worthwhile to investigate this aspect.

ACKNOWLEDGEMENT

Thanks are due to Prof. T. S. Sadasivan for guidance and encouragement, and to the Madras University and the Plant Protection Adviser to the Government of India for permission to undertake the work.

1. Abbot, M. T. J. and Grove, John F., *Exp. Cell Res.*, 1959, **17**, 105.
2. American Phytopathological Society, *Phytopathology*, 1943, **33**, 627.
3. Aytoun, R. S. C., *Ann. Bot. Lond.*, 1956, **20**, 297.
4. Bliss, Eleanor, A. and Long, P. H., *B. U. Johns Hopkins Hosp.*, 1941, **69**, 14.
5. Brian, P. W., *Trans. Brit. mycol. Soc.*, 1960, **43**, 1.
6. Dimond, N. S., *Science*, 1941, **94**, 420.
7. Grove, J. F., Ismay, D., MacMillan, J., Mulholland, T. P. C. and Rogers, M. A. T., *Chem. Ind.*, 1951, No. 11, p. 219.
8. Horsfall, J. G., *Principles of Fungicidal Action*, Chronica Botanica Co., Waltham, Mass., U.S.A., 1956.
9. — and Rich, S., *Phytopathology*, 1953, **43**, 476.
10. Napier, E. J., Turner, D. I. and Rhodes, A., *Ann. Bot. Lond.*, 1956, **20**, 461.
11. * Prusová, Helena, *Ces. Mykol.*, 1962, **16**, 214.
12. Rudd Jones, D. and Wignall, J., *Nature, Lond.*, 1955, **175**, 207.
13. Sexton, W. A., *Chemical Constitution and Biological Activity*, Van Nostrand Co., N.Y., 1953.
14. Sisler, Hugh D. and Cox, Carrol E., In *Plant Pathology: An Advanced Treatise*, Edited by J. G. Horsfall and A. E. Dimond, Academic Press, N.Y. and London, 1960, **2**.
15. Srivastava, S. N. S., "Systemic Fungicides and Host-Parasite Response," *Ph.D. Thesis*, University of Madras, 1964.
16. Woods, D. D., *Brit. J. exp. Path.*, 1940, **21**, 74.

* Original not seen.

FISSION-TRACK AGES OF INDIAN MICAS

S. S. KERE

Department of Physics, Indian Institute of Technology, New Delhi-29 (India)

INTRODUCTION

MANY natural micas contain a large background of charged particle tracks which were first observed by Price and Walker in an electron microscope study of the mineral.¹ Considering various possible origins for the tracks they showed that the most likely source is the slow, spontaneous fission of the U-238 isotope of uranium present in traces.² They can be rendered visible under the optical microscope by etching the mica with hydrofluoric acid.³ The age of the mineral can be determined from the density of such fossil tracks, and of uranium atoms in the mineral.² Various minerals have been dated using this method.⁴⁻⁶

The author has found fossil fission-tracks in three samples from the Nellore mica belt, Andhra Pradesh, and applied this method of dating to two of them from Gudur. Since these tracks anneal out at temperatures above some 200° C., such dating only gives a lower limit to the age of the mineral. This limit of about 500 million years for the samples studied is to be compared to the estimate of about 1,570 million years obtained for this region by other methods.⁹

THEORY

In brief, the theory of fission-track dating as presented by Price and Walker² is as follows: Let ρ_i be the density of background tracks due to spontaneous fission of U-238 on a freshly cleaved and etched surface of mica. The U-content of the mineral can be accurately determined by exposing it to a known dose of thermal neutrons, and measuring the density ρ_s of the fresh tracks produced by induced fission of U-235. From the ratio ρ_s/ρ_i , one can determine the age Λ , assuming that the isotopic ratio of U-235/U-238 in the mica is the same as that in natural uranium. For specimens younger than a billion years the relation simplifies to

$$\frac{\rho_s}{\rho_i} = \frac{\Lambda \lambda_f}{n \sigma I}$$

where λ_f = Decay constant for spontaneous fission of U-238 (6.85×10^{-17} year⁻¹);

σ = Cross-section for thermal neutron-induced fission of U-235 (582×10^{-24} cm.²);

I = Isotopic ratio U-235/U-238 (7.26×10^{-3});

n = Total thermal dose of neutrons. (It is 9.15×10^{16} n/cm.² in this experiment.)

EXPERIMENT

A muscovite and a biotite from Gudur, Andhra Pradesh, were examined. The small pieces were about 1 sq. cm. in area, and 40-60 μ in thickness. They were cleaved into nearly equal slices and their internal surfaces were etched (Table I) with HF acid at room temperature. They were area-scanned under high magnification ($1,500 \times$) to determine ρ_s .

TABLE I

Sample	Etch before irradiation	Etch after irradiation	ρ_s /cm. ²
Biotite (Gudur)	1 min. in 20% HF at 32° C.	1 min. in 20% HF at 30° C.	$2.10 \pm 0.09 \times 10^3$
Muscovite (Gudur)	30 min. in 40% HF at 34° C.	1 hr. in 40% HF at 30° C.	$2.48 \pm 0.35 \times 10^2$

The following facts in confirmation of earlier results were noted^{2,3,8}

- The track-length is typically $\sim 10 \mu$.
- The track-width is proportional to the etching time at a given temperature and a given concentration of acid.
- The etching rate is very sensitive to temperature and increases rapidly with it.
- It is much easier to etch biotite than muscovite.

The density of background tracks in the muscovite was found to be less than that in the biotite by an order of magnitude. But preliminary examination of a greenish track-density in this muscovite is of the same order, i.e., $\sim 10^3$ /cm.², as in the biotite studied.

EXPOSURE

After scanning for background tracks the two halves of each specimen were put together, wrapped in an aluminium foil, and exposed in a reactor to a dose of about 10^{17} neutrons. This dosage was chosen so as to make the ratio $\rho_s/\rho_i \sim 10$, assuming the geological age of the specimens to be about 500 million years, from the dating results for

the mineral from other parts of the world.^{4,8} After irradiation, the specimens were etched out for a proper time, and their internal surfaces were area-scanned for induced tracks.

In the muscovite, the two counts were made on different pieces which came from adjacent portions of a bigger piece. In the biotite, the etching conditions before and after irradiation were nearly the same. It was found that the background tracks were twice as wide as the new ones, since the former had been etched for twice as long. Thus simultaneous track-count could be made for ρ_s and ρ_i over the same area.

DATING RESULTS

The ρ_i data and results are presented in Table II. The atomic concentration of uranium was calculated from the formula:

$$C_u = \frac{1}{N_0 R_0 \sigma I} \left(\frac{\rho_i}{n} \right)$$

where N_0 = number of atoms/cm.³ in mica;
where R_0 = range of fission fragments in mica
($\sim 10 \mu$).

TABLE II

Age and uranium concentration of mica

Specimen	ρ_s /cm. ²	ρ_i /cm. ²	Λ 10 ¹¹ yrs.	Cu atom/ atom
Biotite (Gudur)	2.10 ± 0.09 $\times 10^3$	2.405 ± 0.047 $\times 10^4$	494 ± 24	2×10^{-8}
Muscovite (Gudur)	2.48 ± 0.35 $\times 10^2$	3.385 ± 0.240 $\times 10^3$	411 ± 65	3×10^{-11}

The errors quoted in Table II are statistical errors due to the counting of a finite number of fission-tracks.

DISCUSSION

I note that the ages of the two varieties from the same location are consistent with each other. The age of pegmatites in the region has been determined to be 1,570 million years by other methods.⁹ Ages determined by the

fission-track method tend to err on the young side when compared to other radioactive dating results.^{4,8} This is a consequence of track-fading at high ambient temperatures. It has been estimated that at about 145° C. tracks in muscovite would be stable over the entire age of the earth, while at about 200° C. they would be stable for only a million years.⁴ Hence our dating result gives the time since the mica cooled down to a temperature in the neighbourhood of 145° C. The results seem to indicate that this cooling has taken about a billion years; and also they set a lower limit to the age of the pegmatites of the Nellore mica belt.

ACKNOWLEDGEMENTS

I should like to thank Dr. S. Lokanathan, Physics Department, for his advice and criticism. I am grateful to Prof. W. E. Duncanson, formerly Head of the Physics Department, for suggesting the problem, and making this work possible. I am indebted to Dr. P. Kumar, Department of Civil Engineering, for giving us his laboratory mica specimens for dating, and for helpful discussions. My thanks are due to the Atomic Energy Establishment, Trombay, for irradiation of the samples in their Apsara reactor.

1. Price, P. B. and Walker, R. M., *Nature*, 1962, **196**, 732.
2. — and —, *J. Geophys. Res.*, 1963, **68**, 4847.
3. — and —, *J. Appl. Phys.*, 1962, **33**, 3407.
4. Fleischer, R. L., Price, P. B., Symes, E. M. and Miller, D. S., *Science*, 1964, **143**, 349.
5. — and —, *Geochim. Cosmochim. Acta*, 1964, **28**, 1705.
6. —, — and Walker, R. M., *J. Geophys. Res.*, 1964, **69**, 4885.
7. — and —, *Phys. Rev.*, 1964, **133 B**, 63.
8. Maurette, M., Pellas, P. and Walker, R. M., *Bull. Soc. France Miner. Crist.*, 1964, **87**, 6.
9. Holmes, A., *Proc. Geol. Assocn. Canada*, 1955, **7**, 81; quoted in M. V. N., Murthy's *Mica Fields of India* (Internat. Geol. Congress, 22nd Session, India, New Delhi, 1964).

LETTERS TO THE EDITOR

PARTIAL DOUBLE BOND CHARACTER
OF THE BONDS

THE length of a single bond between two atoms A and B in a molecule is generally less than the sum of the covalent radii of the two atoms. This shortening is primarily attributed to the partial ionic character of the bonds. However, in most of the cases the observed shortening of the bonds is much larger than that theoretically expected on the basis of the partial ionic character.¹ This additional shortening is explained by assigning a double bond character to the bonds. Most of the calculations on the double bond character have been made following this approach.^{1,2} It may be remarked here that these calculations use the values of the partial ionic character obtained by substituting the values of electronegativity of isolated atoms forming the bond. However, in the actual case the electronegativity of an atom in a molecule will be different from that of an isolated atom because it will depend on the electronegativity property of adjacent atoms as well as on its degree of hybridization and so various bond interaction effects make it different.^{3,4} As such, the values of partial double bond character thus evaluated will be erroneous. Goldstein⁵ has suggested a different approach for calculating the double bond character in planar molecules with the help of quadrupole coupling data. This method is limited only to those molecules whose microwave spectra is well studied and show nuclear quadrupole hyperfine structure. In the present note a method for evaluating the partial double bond character has been suggested based on the 'principle of electro-neutrality.'

Consider a bond A-B. Let X_A and X_B be the electronegativities of the atoms A and B. For a two-electron bond the pair of electrons will divide themselves between the two atoms such that a fraction $2X_A/(X_A + X_B)$ of the electron atmosphere is on the atom A and a fraction $2X_B/(X_A + X_B)$ of the electron atmosphere is on the atom B. If it is assumed that the electronegativity of atom A is smaller than that of atom B, the positive charge that would be placed on atom A due to partial ionic character is given by $[1 - (2X_A)/(X_A + X_B)]$. The same amount of charge would be placed on atom B but with an opposite sign. Exceptionally large charges may result from the partial ionic

character of the bonds between atoms having a great difference in their values of the electronegativity, if there is no way in which the charges can be reduced. The electron donors such as the halogen and oxygen atoms are able under these circumstances to swing another pair of electrons into position for bond formation and the electron acceptors such as the cyanide and nitro groups are able to provide an orbital for a pair of electrons from the rest of the molecules, thus giving some double bond character to the bond. This amount of double bond character can be estimated by introducing the concept of electroneutrality according to which, in general, the electronic structures of substances are such as to cause each atom to have essentially zero resultant electric charge. Now the charge $[1 - 2X_A/(X_A + X_B)]$ or $(X_B - X_A)/(X_A + X_B)$ would be reduced to zero if this bond has $|X_A - X_B|/(X_A + X_B) \times 100\%$ partial double bond character. Hence, Percentage Partial Double Bond Character = $|X_A - X_B|/(X_A + X_B) \times 100\%$. For polyatomic molecules the value of group electronegativity is to be used in the above expression.

The calculated values of the partial double bond character are given in Table I along with

TABLE I
Partial double bond character of
carbon-halogen bonds in some molecules

Substance	Percentage partial double bond character	
	Calculated	Experimental
CH ₂ : CHCl	7.7	6 ⁵
CH ₂ : CHBr	4.3	4.4 ⁶
CH ₂ : CHI	0.5	3 ⁵
CH ₃ COCl	8.3	9.3 ± 3 ⁷
CH ₃ COBr	4.9	8 ³

the experimental values. It is obvious from the table that the calculated values are in reasonably good agreement with the experimental values. This method of evaluating double bond character involves only the knowledge of the values of X_A and X_B which can very easily be obtained.³ Goldstein's⁵ experimental method, though accurate, is somewhat complicated in analysis and hence applicable to limited molecules.

I am grateful to Professor Krishnaji for his kind interest and help.

Physics Department, SURESH CHANDRA.
University of Allahabad, India,
May 30, 1966.

1. Pauling, L., *The Nature of the Chemical Bond*, 3rd edition, Cornell University Press, Ithaca, New York, 1960.
2. Brockway, L. O., *J. Phys. Chem.*, 1937, **41**, 185.
3. Chandra, S. and Chandra, S. (Communicated).
4. Wilmschurst, J. K., *J. Chem. Phys.*, 1957, **27**, 1129.
5. Goldstein, J. H., *Ibid.*, 1956, **24**, 106.
6. Howe, J. A. and Goldstein, J. H., *Ibid.*, 1956, **27**, 831.
7. Sinott, K. M., *Ibid.*, 1961, **34**, 851.
8. Krisher, L. C., *Ibid.*, 1960, **33**, 1237.

NEAR ULTRAVIOLET EMISSION SPECTRUM OF 1-2 FLUOROTOLUENE VAPOUR

THE spectroscopic studies of 1-2-fluorotoluene molecule have been made by various workers in optical and infrared regions.¹⁻⁵ In order to fix the ground state vibration frequencies a detailed study of the emission spectrum of 1-2-fluorotoluene was undertaken.

The emission spectrum was obtained in an uncondensed transformer discharge through the flowing vapour of the substance. The spectrum was photographed on Hilger medium quartz spectrograph with a slit width of 25μ and a dispersion of about 11 Å/mm. at 2600 Å. Kodak II-O plates were used for photographing the spectrum with an exposure time of 15 to 20 hours.

About twenty bands could be recorded in the region 37010-37625 cm^{-1} . The (0, 0) band has been identified at 37560 cm^{-1} which is faint in intensity (due to self-absorption by the cold vapour near the observational window). It may be mentioned that in the near ultraviolet absorption spectrum of 1-2-fluorotoluene in the vapour phase Joshi³ has reported the (0, 0) band at 37567 cm^{-1} which is very strong.

TABLE I

Raman (Liquid)		Infrared (Liquid)	Emission (vapour)	Assignment
Thompson and Temple ⁴ (cm^{-1})	Deb ⁵ (cm^{-1})	Thompson and Temple ⁴ (cm^{-1})		
185 (6) D	190 (6b)	..	150 m	a''
			200 m	a''
275 (5) D	272 (6b)	..	270 m	a''
			367 w	a''
526 (5) D	526 (3b)	528 s	532 ms	a'

D=Depolarised, b=Broad, s=Strong, ms=Medium strong, m=Medium, w=Weak. The number in brackets represent relative intensity.

The molecule 1-2-fluorotoluene ($\text{FC}_6\text{H}_4\text{CH}_3$) may belong to Cs point group having only one

element of symmetry, namely, the plane of the molecule, if we assume that 'CH₃' substituent behaves as a single atom and both the substituents lie in the plane of the ring. Thus the emission spectrum obtained in this case may be attributed to $^1\text{A}'-^1\text{A}'$ transition. Ground state fundamental frequencies observed in the emission spectrum along with Raman and infrared frequencies are represented in Table I.

Department of Spectroscopy, GAJANAN JOSHI.
Banaras Hindu University,
Varanasi-5, India, April 26, 1966.

1. Cave, W. T. and Thompson, H. W., *Disc. of Faraday Soc.*, 1950, **9**, 35.
2. Sen, S. K., *Ind. J. Phys.*, 1920, **34**, 239.
3. Joshi, G., *Ind. J. Pure and Appl. Phys.*, 1966, **4**, 40.
4. Thompson, H. W. and Temple, R. B., *J. Chem. Soc.*, 1948, Part II, p. 1432.
5. Deb, K. K., *Ind. J. Phys.*, 1962, **36**, 59.

UPTAKE OF CESIUM-137 BY KATELYSIA MARMORATA

CESIUM-137 is a fission product with a long half-life (30 years), occurring in the marine environment mainly through global fall-out. It has been reported that this isotope is accumulated to relatively high levels in the soft tissues of shell-fish.¹ Hence, it was decided to study the uptake of Cs-137 by the clam, *Katelysia marmorata* Lam. (Fam. Veneridae) under laboratory conditions. This species is common in sandy mud and constitutes a major shell-fishery.

The clams collected from the intertidal region at Mahim (Bombay) were first conditioned in the laboratory for one day. Groups of 13 specimens (length = 2.5 cm.) were kept in four polythene aquaria, each containing 2 litres of sea-water at 26°-31° C. Two aquaria contained 0.48 μC . and the other two 0.24 μC . of carrier-free Cs-137. Samples of clams were removed after immersion periods ranging from 16 to 168 hours and the soft parts dissected out for counting. 2 ml. samples of the medium were also taken simultaneously. These samples were counted for Cs-137 in a gamma spectrometer. The concentration factors (CF) were calculated by dividing the counts per minute per g. of soft parts by c.p.m. per ml. of medium. The results are illustrated in Fig. 1.

In an experiment to study the loss of Cs-137 from the animal to sea-water, 18 clams were kept for a day in sea-water containing Cs-137. They were then transferred to non-active sea-water. Samples of clams were sacrificed for counting at one-day intervals. The medium was

also changed every day. The results are given in Table I.

TABLE I
Loss of Cs-137 in non-active medium

Days	Mean c.p.m. per g. of soft parts
0	98.9
1	56.0
2	37.0
3	33.3
4	22.4

The results show that both the uptake and loss of Cs-137 in *K. marmorata* are rapid during the first day. No significant difference was observed between the CFs reached in the two concentrations of Cs-137, at each time interval. The CF for the radionuclide, at equilibrium, was 10, which was reached after 65-70 hours (Fig. 1). About 77% of the initial activity

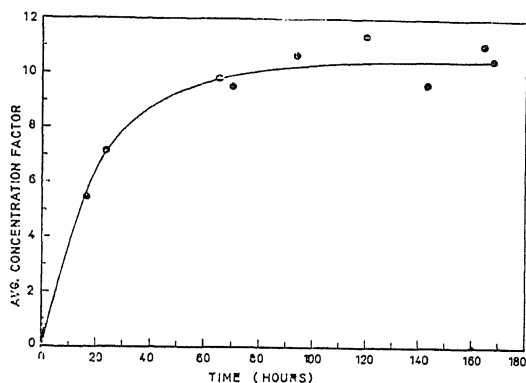


FIG. 1. Uptake of Cs-137 by the soft parts of *K. marmorata*.

was lost from the soft parts after 4 days of submergence in non-active water. Boroughs *et al.*² observed a CF of 8 for Cs-137 in *Pecten irradians* L. after 10 days and a CF of 6 in *Venus mercenaria* L. after 20 days. Bryan³ found that an equilibrium CF of 9.2 was reached in *Mytilus edulis* L. after 1,400 hours. These figures agree very well with the equilibrium CF of 10 obtained for *K. marmorata* in the present studies.

I am grateful to the International Atomic Energy Agency, Vienna, for financing this work under Research Contract No. 155/RB, and to Dr. A. K. Ganguly, Head, Health Physics Division, AETT, for his advice and encouragement.

Health Physics Division, Y. M. BHATT.
Atomic Energy Estab., Trombay,
Bombay-74 AS, September 12, 1966.

1. Chipman, W. A., *Conf. Proc. Disposal of Radioactive Wastes*, Vienna International Atomic Energy Agency, 1960, 2, 4.
2. Boroughs, H., Chipman, W. A. and Rice, T. R., Chapter 8 in *The Effects of Atomic Radiation on Oceanography and Fisheries*, N.A.S.-N.R.C. Publ. 551, Washington, 1957.
3. Bryan, G. W., *J. mar. biol. Ass., U.K.*, 1963, 43, 519.

EMISSION SPECTRUM OF PARA-FLUOROANILINE

In continuation of our work on the ultra-violet absorption^{1,2} and infra-red spectra³ of fluoroanilines, we have undertaken a study of emission spectra of these molecules. While this work was in progress, two notes have appeared on the emission spectra of meta- and ortho-fluoroanilines.^{4,5} In this communication, we report our results on the near ultra-violet emission spectrum of para-fluoroaniline.

The emission spectrum was excited by an uncondensed transformer discharge at a voltage of about 1,600 volts through the flowing vapour of the substance in a π -type discharge tube, diameter 1.6 cm. and length 30 cm. The spectrum was photographed on a medium quartz spectrograph, with an exposure of about 6 hours. The spectrum occurring in the region 3625-3020 Å consists of about 20 rather broad bands overlapped by a fairly strong continuum. With the band at 32673 cm.⁻¹ chosen as (0, 0) band, all the bands in the spectrum have been accounted for on the basis of seven ground state and three excited state fundamental frequencies. These fundamental frequencies are given in Table I, in which are also given, for

TABLE I

	Ground state fundamentals in cm. ⁻¹	Excited state fundamentals in cm. ⁻¹
Emission spectrum	.. 174, 370, 464, 623, 847, 1275, 1346;	183, 320, 423
Ultra-violet absorption spectrum	.. 153, 457,	186, 311, 422
Infra-red spectrum	.. 835, 1275, 1325;	
Raman spectrum	.. 164 362, 452, 635, 844, 1265;	

comparison, the corresponding fundamentals obtained from ultra-violet absorption, infra-red and Raman spectra.⁶

Department of Physics, M. A. SHASHIDHAR.
Karnatak University, K. SURYANARAYANA RAO.
Dharwar-3, July 25, 1966.

1. Shashidhar, M. A. and Rao, K. S., *Curr. Sci.*, 1965, **34**, 479.
2. — and —, *Ind. J. Phys.*, 1966, **40**, 53.
3. —, — and Jayadevappa, E. S., *Ind. J. Pure and Appl. Phys.*, 1966, **4**, 170.
4. Verma, P. K., *Curr. Sci.*, 1966, **35**, 145.
5. Singh, S. N. and Singh, N. L., *Ibid.*, 1966, **35**, 360.
6. Kohlrausch, K. W. F. and Ypilanti, G. P., *Mh. Chem.*, 1935, **66**, 285.

ALKALOIDAL CONSTITUENTS OF CROTALARIA GRAHAMIANA

IN recent years several species of *Senecio*, *Crotalaria*, *Heliotropium* and other plants have become known as cattle poisons.¹ The plant *Crotalaria grahamiana* is used as green manure in Kerala State, since it is a rich source for nitrogen. Though some of the *Crotalaris* are used as drugs in indigenous medicine for treatment of some ailment or other,² there is no mention about the medicinal uses of this plant in the literature. Neither the plant nor the seeds of *C. grahamiana* seem to have been investigated earlier.

For the present study, the seeds were collected during summer months of 1964, near Alleppey (Kerala State). The coarsely powdered seeds (6 kg.) were percolated with hot ethanol and the percolate concentrated to small bulk. It was made acidic with an equal volume of 10% aqueous citric acid and the remaining ethanol was distilled under reduced pressure. After extraction with petroleum ether, and ether to remove sterols and fatty components, the solution was made basic with ammonia and the alkaloidal constituents extracted exhaustively with chloroform. The extract was dried, concentrated to a small volume and cooled to yield a crystalline substance (A_1), which answered alkaloidal reactions and on paper chromatography using different solvent systems gave a single spot. The mother liquor on further concentration yielded a second crop (B), which on paper gave two spots; one of them was same as that of A_1 . Neither of these fractions gave red colouration with boiling acetic anhydride, indicating the absence of N-oxides.

The aqueous basic solution left after extraction with chloroform did not contain N-oxides since reduction and subsequent extraction did not yield any tertiary amine.

TABLE I

Solvent system	R_f values			
	Ascending		Descending	
	A_1	A_2	A_1	A_2
(i) <i>n</i> -Butanol: Acetic acid: water (60:15:25)	0.59	0.96	0.57	0.77
(ii) <i>n</i> -Butanol: Ammonia: water (30:1:5)	0.88	0.95	0.86	0.94

The fraction A_1 was purified by passing through a column of neutral alumina and by crystallisation from ethanol, when it came out as colourless needles, m.p. 196° C., yield 12 gm. $[\alpha]_D^{20}$, -21.7° (abs. ethanol). The infra-red spectrum (in KBr) showed hydroxyl and ester carbonyl at 3571 and 1742 cm^{-1} respectively. The base gave a methiodide, which crystallised from ethanol-ether as colourless long needles, m.p. 205° (d). Catalytic hydrogenation using Pd/CaCO_3 (6%) gave a necine, m.p., 77° C. (Lit.³ m.p. for desoxyretronecine 77-78° C.) and a necic acid, m.p. 181° C. (Lit.³ m.p. of monocrotalic acid 181-182° C.). These properties and reactions indicated that the base was monocrotaline and this was confirmed by direct comparison with an authentic sample kindly supplied by Prof. Roger Adams; the mixed m.p. was undepressed.

The fraction B and the final chloroform mother liquor were combined and separated into the major constituent monocrotaline and a base (A_2) by chromatographing over a column of neutral alumina (activity 1) using chloroform as eluting solvent.

The minor base A_2 crystallised from ether as colourless slender rods, m.p. 160-61° (d), yield 300 mg. $[\alpha]_D^{20}$, +125.7° (abs. ethanol). It is more soluble in alcohol, ether and other solvents than monocrotaline and gave a methiodide m.p. 240-41° (d). Its elemental analysis agree with the formula, $\text{C}_{18}\text{H}_{25}\text{NO}_6$ which was supported by the analysis of its methiodide. It has no methoxyl but has 3 C-methyl groups (Found: C-methyl 13.4%, $\text{C}_{18}\text{H}_{25}\text{NO}_6$ requires 12.7% for 3 methyls). The infra-red spectrum (in KBr) showed saturated and unsaturated ester carbonyl and isopropyl at 1751, 1731, 1365 and 1375 cm^{-1} respectively. The n.m.r. spectrum of the base in CDCl_3 gave signals at 4.2 τ (olefinic proton) and at 8.29, 8.59, 8.75, 8.92 τ (due to methyl protons). On hydrolysis with aqueous barium hydroxide it gave a necic acid, which is still under study. However, the necine was identified by paper chromatography to be retronecine. The properties and reactions of

the minor base do not agree with any of the pyrrolizidine alkaloids hitherto described.

Department of Chemistry, R. N. GANDHI.
University of Delhi, T. R. RAJAGOPALAN.
Delhi-7, August 29, 1966. T. R. SESHADRI.

1. Rajagopalan, T. R. and Seshadri, T. R., *Curr. Sci.*, 1964, **33**, 163.
2. Nadkarni, K. M., *The Indian Materia Medica*, Vol. 1, p. 391.
3. Adams, R., Shafer, P. R. and Braun, B. H., *J. Am. Chem. Soc.*, 1952, **74**, 5614.

OCCURRENCE OF 22-DIHYDROERGOSTEROL IN POLYPORUS PARGAMENUS FRIES

Polyporus pargamenus Fries is a wood-rotting fungus found in many parts of the world particularly America. A survey of the literature showed that it has not been chemically investigated so far. The results of our chemical work on this fungus, collected near Bhundyar village (Western Himalayas, alt. 9,000 ft.) are recorded herein.

The petroleum ether extract of the fungus was subjected to chromatography over neutral alumina. Chloroform and chloroform-acetone (19 : 1) eluted a substance which crystallised from acetone as colourless needles, m.p. 150–51°, $[\alpha]_D^{25}$, –93.2°, formula $C_{28}H_{46}O_2$, H_2O . In the Liebermann-Burchard colour reaction it showed a red colour changing to blue and finally green. It showed a positive Tortelli-Jaffe colour reaction. The infra-red spectrum showed absorptions at 3597 cm^{-1} (free-OH) and 1653 cm^{-1} (triply subst. double bond). Its ultra-violet spectrum showed absorption maxima at 260, 271, 282 and 293 $m\mu$. It formed an acetate (pyridine-acetic anhydride, cold), colourless needles, m.p. 165–66°, $[\alpha]_D^{25}$, –86.8°. Perbenzoic acid titration of the parent substance showed the presence of two ethylenic double bonds. These properties indicated that the substance could possibly be 22-dihydroergosterol. But since only one derivative, viz., the acetate, has been described in the literature for this sterol, in order to establish the identity beyond doubt 22-dihydroergosteryl acetate was prepared synthetically starting from ergosteryl acetate following the methods described in the literature. The maleic anhydride adduct of ergosteryl acetate was prepared according to details given by Inhoffen.¹ The final yield of the pure adduct was almost doubled as compared with the reported yield, by carrying out a chromatography over a silica gel column. The adduct was eluted by benzene-chloroform (9 : 1) and it crystallised from

methanol as colourless needles, m.p. 210–12°. From this adduct the 22, 23-dihydro derivative, m.p. 195–98°, was prepared by catalytic hydrogenation using palladium-charcoal as catalyst. Heating this product in vacuum at 220° for one hour as described by Windaus and Langer² yielded 22-dihydroergosteryl acetate, which crystallised from methanol as colourless needles, m.p. 160–62°. The mixed melting point of this and the natural acetate was undepressed, the R_f values were identical and the infra-red spectra were completely superimposable.

The following properties of 22-dihydroergosterol have not been previously described and we therefore describe them here. The benzoate (pyridine-benzoyl chloride, hot) $C_{35}H_{50}O_2$ crystallised from chloroform-methanol as colourless needles, m.p. 156–57°, $[\alpha]_D^{25}$, –17.3°. R_f values observed in T.L.C. employing silica gel plates and the solvents mentioned were as below; to make the spots visible 10% aqueous sulphuric acid was employed as the spray reagent and the plates were heated at 110° for 10 min.: 22-Dihydroergosterol, 0.74 (Chloroform-Methanol, 19 : 1); Acetate, 0.47 (Benzene); Benzoate, 0.92 (Benzene).

22-Dihydroergosterol was first isolated from the unsaponifiable lipid fraction from ergot³ and has been subsequently reported to be present in grape seed oil.⁴ It has not so far been reported from any wood-rotting fungus.

It is noteworthy that in the fungus now examined, no sterol other than 22-dihydroergosterol was present and the sterol appeared to be present in the free state, since no more of it could be obtained, even after chromatography, from the unsaponifiable matter of the combined amorphous residues in the chromatogram mentioned earlier.

The authors are grateful to Prof. T. R. Seshadri, F.R.S., for his kind interest, Dr. B. K. Bakshi for the identification of the fungus and Drs. K. G. Sarma and P. S. Rao for the collection of the fungus.

Department of Chemistry, PRATAP SINGH.
University of Delhi, S. RANGASWAMI.
Delhi-7, May 31, 1966.

* All the rotations were taken in chloroform solution and all the substances analysed correctly for C and H.

1. Inhoffen, H. H., *Ann.*, 1933, **508**, 81.
2. Windaus, A. and Langer, R., *Ibid.*, 1933, **508**, 105.
3. Santos Ruiz, A., *Anales real acad. farm.*, **3**, 201; *Anales farm. biogum.*, (Buenos Aires), 1943, Suplemento **14**, 14; *Chem. Abs.*, 1944, **38**, 503.
4. Rubio, M. S., *Farm. nueva*, 1943, **8**, 15, 68, 141, 211; *Chem. Zent.*, 1944, **1**, 132; *Chem. Abs.*, 1945, **39**, 2895.

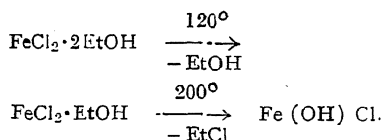
ALCOHOLATES OF FERROUS CHLORIDE

THE reactions of alcohols on ferric chloride have recently been studied¹ and are known to form di-alcoholates. With a view to study the formation of such complexes when iron is in the lower oxidation state of +2, the alcoholates of ferrous chloride have now been prepared. Anhydrous ferrous chloride reacts with methyl, ethyl, *n*-propyl and isopropyl alcohols to give compounds which conform to the general formula $\text{FeCl}_2 \cdot 2\text{ROH}$.

Anhydrous ferrous chloride was prepared by strongly heating iron powder in the presence of dry hydrogen chloride gas. A white pearly crystalline compound of the formula FeCl_2 was obtained. To ferrous chloride (3 g.), benzene (50 g.) and ethyl alcohol (40 g.) were added dropwise and a vigorous reaction took place. After cooling, the solution was evaporated to dryness under reduced pressure. A pasty mass was obtained. To this benzene (10 g.) was added and the solution evaporated to dryness. A light pink solid (3.2 g.) was obtained which on analysis was found to be $\text{FeCl}_2 \cdot 2\text{EtOH}$ (Found: Fe, 25.50; Cl, 32.21; OEt, 40.95; $\text{FeCl}_2 \cdot 2\text{EtOH}$ requires Fe, 25.57; Cl, 32.42; OEt, 41.09%).

Methyl, *n*-propyl and isopropyl alcoholates were similarly prepared by the action of anhydrous ferrous chloride on the appropriate alcohols. The higher alcoholates could not be prepared by alcohol interchange method² as the complex got oxidised to the ferric state.

When the di-ethyl alcoholate was heated to 120° C., the resulting compound on analysis was found to be ferrous chloride mono-alcoholate. Heating was then continued to 200° C, ferrous hydroxy chloride was formed according to the following reaction:



All the alcoholates described above are easily hydrolysed and the usual precautions³ had to be taken to exclude moisture. Iron was determined gravimetrically as ferric oxide after dissolving the sample in dilute nitric acid, the chloride by Volhard's method in nitric acid solution, methoxide, ethoxide and isopropoxide by the chromic acid method.⁴

The authors are grateful to Prof. T. R. Seshadri, F.R.S., for his valuable suggestions.

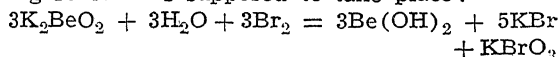
Department of Chemistry,
University of Delhi,
Delhi-7, May 24, 1966.

B. D. JAIN.
R. K. MULTANI.

1. Multani, R. K., *Ind. Jour Chem.*, 1964, p. 506.
2. Bradley, D. C., Multani, R. K. and Wardlaw, W., *Jour. Chem. Soc.*, 1958, p. 4153.
3. —, — and —, *Ibid.*, 1958, p. 4647.
4. —, Halim, F. M. A. and Wardlaw, W., *Ibid.*, 1950, p. 3450.

A NEW METHOD FOR THE RAPID ESTIMATION OF BERYLLIUM

BERYLLIUM can be estimated as oxide by precipitating it from concentrated potassium (or sodium) beryllate by the addition of bromine. When a solution of bromine water is added to a hot potassium beryllate solution, the following reaction is supposed to take place:



The precipitate of beryllium hydroxide obtained under conditions to be described below, is highly dense and granular and can be filtered and washed in a very short time. The method gives good results for the estimation of beryllium in the range of 20–80 mg. BeO. The quantitative estimation can be extended to 100 mg. BeO by adding 2 gm. of ammonium chloride prior to the addition of alkali.

Procedure.—The beryllium solution containing 20–80 mg. BeO is taken in a 250 ml. pyrex conical flask. The volume of the solution is adjusted to about 30 ml. and 20% potassium hydroxide is added slowly while the flask is shaken vigorously until the precipitate first formed is almost redissolved leaving a faint turbidity. The flask is shaken for a few more minutes when the turbidity disappears leaving a clear solution. To the gently boiling solution, saturated bromine water is added dropwise until the solution attains a distinct yellow colour. The solution is then diluted to about 75 ml. and the boiling is continued for 15 minutes. The flask is cooled and any bromine remaining is destroyed by adding one or two drops of alkali. The precipitate is filtered through a Whatman-41 paper with a little pulp at the apex, washed with 5% ammonium nitrate solution, dried at 80° for 30 minutes and ignited to the oxide at 1000° in a platinum crucible. The results are given in Table I.

The method may be used for the separation of beryllium from chromium on the lines described by Jacob¹ in the case of separation of aluminium from chromium.

It is significant to note that ammonium salts which interfere in the precipitation of beryl-

lithium hydroxide by boiling a dilute beryllate solution,² do not interfere in the present method.

TABLE I
Estimation of beryllium as oxide

BeO taken (mg.)	BeO obtained (mg.)
26.4	26.2
39.6	39.5
50.9	50.7
52.8	52.6
66.0	65.9
76.4	76.2
79.2	79.0
92.4	91.6 (92.6*)
101.8	100.0 (101.0*)

* 2 gm. of ammonium chloride added prior to the addition of alkali.

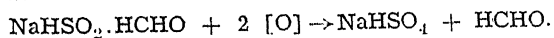
One of us (T.P.P.) thanks the Council of Scientific and Industrial Research for the award of a Junior Research Fellowship.

Department of Chemistry, M. N. SASTRI.
Andhra University, T. P. PRASAD.
Waltair, April 14, 1966.

1. Jakob, W., *Ann. Kroat. Akad.*, Serie A, 1913, p. 756.
2. Prasad, T. P. and Sastri, M. N., Unpublished studies.

OXIDIMETRIC ESTIMATION OF SODIUM FORMALDEHYDE SULPHOXYLATE

Sodium formaldehyde sulphonylate or rongalite is a stable condensation product of sodium sulphonylate and formaldehyde and finds its application in textile industry as a printing reducing agent. The reducing action of this compound is traced to the ready oxidation of its divalent sulphur to the hexavalent state. Even mild oxidants such as copper sulphate,¹ iodine² and chloramine-T³ solutions can rapidly oxidize the sulphonylate part of rongalite and hence serve as reagents for the volumetric estimation of rongalite in aqueous solution. In the present investigations, oxidation of rongalite with oxidants such as potassium iodate, potassium periodate and H_2O_2 was studied and it was found that the oxidation in each case followed the stoichiometry:



The fact that the organic part of the molecule was unaffected by the oxidants under the present experimental conditions was shown by separate blank experiments. Aliquots of the oxidant solutions with and without the added formaldehyde (about 2.0×10^{-3} moles) gave the same titer. Further, the presence of free formaldehyde in the oxidized solutions of

rongalite could be detected by the conventional spot tests.⁴

Sodium formaldehyde sulphonylate, $NaHSO_2 \cdot HCHO \cdot 2H_2O$ (May and Baker sample) was used after purification by repeated recrystallization from aqueous solution. (Sulphur content found 20.84%; theoretical 20.78%). About 0.5 gm. of the purified sample was accurately weighed and dissolved in 250 ml. of deaerated double distilled water. Solutions of potassium iodate, potassium periodate and sodium thiosulphate were prepared from 'analar' reagents, while Merck sample H_2O_2 (20 volumes) was suitably diluted to give an approximately decinormal solution.

The following experimental conditions were found to be satisfactory for the volumetric analysis of rongalite in aqueous solution.

(a) *Oxidation with KIO_3* .—Aliquot portions of rongalite solution were added to an acidified mixture of 20 ml. of 0.1 N KIO_3 and 20 ml. of 2 N HCl in a stoppered conical flask. The reaction mixture was shaken and after 5 minutes 20 ml. of distilled water and 10 ml. of 10% KI solution were added. The liberated iodine was titrated against N/10 sodium thiosulphate using starch indicator.

(b) *Oxidation with KIO_4* .—A known volume of rongalite solution was pipetted into a mixture of 25 ml. of approximately decinormal KIO_4 and 20 ml. of 1 N HCl in a stoppered conical flask. The reaction mixture was shaken and set aside for 3 minutes. Then 20 ml. of distilled water and 10 ml. of 10% KI were added and the liberated iodine was estimated by N/10 thiosulphate using starch indicator.

(c) *Oxidation with H_2O_2* .—Aliquot portions of rongalite solution were pipetted into 25 ml. of approximately N/10 H_2O_2 and 15 ml. of 2 N NaOH were added. The reaction vessel was stoppered and set aside for 30 minutes. About 50 ml. of 2 N HCl and 10 ml. of 10% KI were then added and the excess H_2O_2 was estimated by the iodometric titration.

A blank titration was carried out with aliquots of each of the oxidant solutions and by difference, the number of equivalents of oxidant consumed per mole of rongalite was calculated. These results have been recorded in Table I.

An inspection of Table I shows that 4 equivalents of the oxidant are required for a partial oxidation of a mole of rongalite and the reproducibility of the results indicates that any of the above oxidizing agents can be used for the volumetric estimation of the sulphur compound in aqueous solution.

TABLE I
Oxidation of ronalgite with KIO_3 ,
 KIO_4 and H_2O_2

Experiment No.	Amount of ronalgite taken moles $\times 10^5$	No. of equivalents of oxidant consumed $\times 10^5$	No. of equivalents of oxidant per mole of ronalgite	Oxidant
1	10.19	40.73	3.99	KIO_3
2	20.52	81.83	3.99	"
3	27.84	112.67	4.05	"
4	34.80	141.13	4.05	"
5	41.76	168.41	4.03	"
6	48.72	195.69	4.02	"
7	54.72	220.59	4.03	"
8	61.56	246.70	4.01	"
9	13.25	53.75	4.06	KIO_4
10	19.87	79.55	4.00	"
11	26.50	106.42	4.01	"
12	45.78	184.90	4.04	"
13	58.86	237.58	4.04	"
14	100.10	397.80	3.98	"
15	114.56	455.80	3.98	"
16	6.48	25.70	3.97	H_2O_2
17	12.95	52.42	4.05	"
18	25.90	103.82	4.01	"
19	32.38	129.52	3.99	"

Dept. of P.G. Studies and D. S. MAHADEVAPPA.
Research in Chemistry, MARIGANGIAH.**
Manasa Gangotri,
Mysore-6, India, May 9, 1966.

** Department of Chemistry, Medical College, Mysore.

1. Helwig, E. L., *Am. Dyestuff Reporter*, 1920, 7, II, No. 15; *Through Chem. Abstr.*, 1921, 15, 2045.
2. Maros, L., *Magyar Kem. Folyoirat*, 1953, 64, 41; *Through Chem. Abstr.*, 1958, 52, 11661.
3. Mahadevappa, D. S., *Curr. Sci.*, 1964, 33, 710.
4. Feigl, F., *Spot Tests in Organic Analysis*, Elsevier Publishing Co., Amsterdam, 1956, p. 334.

TRITERPENOID COMPONENTS OF THE LEAVES AND PODS OF *WRIGHTIA TINCTORIA*

THE stem bark of *Wrightia tinctoria* Br. (Fam: Apocyanaceae) was examined by Rangaswami and Rao¹ and found to contain β -amyrin, lupeol, β -sitosterol and a new triterpenoid. The results of the chemical examination of the leaves and pods are now reported in this note.

From the powdered leaves β -amyrin was isolated through its benzoate. From the pods ursolic acid was obtained besides another triterpene acid. The identity of β -amyrin and ursolic acid and their derivatives has been established by colour reactions, elemental analysis, optical rotation and by mixed melting point with authentic samples.

The powdered leaves were extracted successively with petroleum ether, chloroform, and

alcohol. The chloroformic and alcoholic extracts were highly coloured, but no crystalline component could be isolated so far except potassium oxalate from the latter. The petroleum ether extract residue was saponified and the non-saponifiable matter was benzoylated with pyridine and benzoyl chloride. The product on repeated crystallizations from chloroform and alcohol gave colourless shining plates (yield, 0.15%), m.p. 229–31°, $[\alpha]_D^{29} = +98.2^\circ$ (chf.). It gave a positive Liebermann-Burchard reaction. Its colour reactions and other properties suggested it might be identical with β -amyrin benzoate* and a mixed m.p. determination with an authentic sample¹ of β -amyrin benzoate confirmed the identity. Further confirmation was obtained by hydrolysing the benzoate to give a compound, m.p. 190–92°, $[\alpha]_D^{29} = +80.1^\circ$ (chf.). Colour reactions of this compound were the same as reported for β -amyrin. Mixed m.p. with an authentic sample of β -amyrin¹ was undepressed.

The powdered pods (freed from seeds) were extracted with hexane followed by hot chloroform. The hexane extract gave a mixture of terpenoids. The chloroform extract on concentration deposited a solid which was repeatedly digested with hot benzene-alcohol. Concentration of the benzene-alcohol solution gave a pale green amorphous solid. This was again dissolved in hot benzene-alcohol, treated with charcoal and filtered. The filtrate on concentration gave colourless needles (yield, 0.14%), m.p. 280–82°, $[\alpha]_D^{29} = +63^\circ$ (alc. KON 1N). In the Liebermann-Burchard reaction it gave a pink colour changing to violet, blue and green. The solubility properties, colour reactions, optical rotation and analysis indicated that it might be identical with ursolic acid. A mixed m.p. with an authentic sample of ursolic acid² was undepressed. The identity was further confirmed by the preparation of the following derivatives.

The acetate (pyridine-acetic anhydride) crystallised from alcohol as colourless needles, m.p. 286–88°, $[\alpha]_D^{29} = +64.4^\circ$ (chf.). The methyl ester prepared with diazomethane crystallized from petroleum ether as feathery needles, m.p. 114–15°, $[\alpha]_D^{29} = +90^\circ$ (chf.). This acetyl derivative of the methyl ester crystallized from alcohol as white needles, m.p. 238–40°, $[\alpha]_D^{29} = +63.1^\circ$ (chf.). Mixed m.p. of the acetate, the methyl ester and its acetate with the corresponding authentic derivatives of ursolic acid² were undepressed.

A crystalline solid was obtained from the mother liquors of ursolic acid which when

chromatographed over silica gel gave three crystalline substances. Two of them were obtained in very small quantities while the third one could be obtained in relatively good yield (0.1%) as a micro-crystalline solid from chloroform-methanol, m.p. 262-64°, $[\alpha]_D^{20}$ +100.6 (methanol). It gave a positive Liebermann-Burchard reaction and formed a methyl ester with diazomethane, feathery needles from alcohol, m.p. 130-31°, $[\alpha]_D^{20}$ +65° (chl.) showing that it might be a triterpene acid. The properties of this substance do not seem to correspond with any of the known compounds.

One of the authors (M. N. R.) thanks the Government of India for a scholarship. Thanks are due to Dr. K. Sambamurthy for supplying samples of authentic ursolic acid and its derivatives for comparison.

Department of Pharmacy, M. NAGESWARA RAO,
Andhra University, E. VENKATA RAO.
Waltair, April 8, 1966. V. SUBBA RAO.

* All the substances described in this note gave satisfactory elemental analysis.

1. Rangaswami, S. and Nageswara Rao, M., *Proc. Indian Acad. Sci.*, 1963, **57A**, 115.
2. — and Sambamurthy, K., *Ibid.*, 1957, **46A**, 245.

NORTHERN LIMIT OF SYLHET TRAP

The area around Umstew, in which the present geological investigation has been done, is on the southern slope of the Shillong plateau occupying a part of the Cherrapunjee, and lies between Lat. 25° 15' 20" and 25° 20' 30" N. and Long. 91° 41' 0" and 91° 45' 0" E. in toposheet 78 0/11.

Medlicott (1869) who did the pioneer geological mapping of this part of the plateau, named the basaltic flow found here, as the 'Silhet trap' as it is best exposed in the vicinity of the Sylhet plains.

In his map, Medlicott traced the extension of this trap rock up to 'Tarna' on the north, to 'Maoelung' on the south, and on the east and west up to Um Tangsiang and Bogapani rivers respectively. From his map it is clear that the rock type occupies the area within these boundaries except for a small gap between 'Sobar' and 'Vulang'. Ghosh (1940) who remapped the area has shown that its northern limit extends to 2 km. south of Mawmluh. Recent geological mapping (Dutta, 1964) shows that the northern limit of this basaltic flow extends to the gorge face of 1023' falls (91° 43' 0" : 25° 19' 0") near Umstew about 12 km. further north. Ghosh who studied the strati-

graphic succession on this gorge face has not reported the occurrence of the trap there.

The rock type is a dolerite or basalt, sometimes with olivine and more or less serpentized. It is invariably black in colour. The variety exposed here is amygdaloidal, the amygdules being filled with chalcedony and calcite. The constituent minerals are olivine, pyroxene and plagioclase while magnetite, serpentine, iddingsite form secondary minerals.

In this section the trap fills the depressions on the uneven pre-trap land surface formed by the granite. The age of the Sylhet trap is Middle Jurassic and on lithological similarity it has been equated with the Rajmahal trap.

From the above discussions, it has been concluded that in the Khasi Hills, Umstew is the northern limit of the Sylhet trap.

The author is indebted to Sri. B. C. Barooah and Sri. K. C. Bardoloi, Directorate of Geology and Mining, Assam, for their kind help during field work.

Directorate of Geology
and Mining,
Assam, April 12, 1966.

S. K. DUTTA.

1. Medlicott, H. B., *Geological Sketch of the Shillong Plateau in North-Eastern Bengal. Mem. G.S.I.*, 1869, **7**, 1.
2. Ghosh, A. M. N., *The Stratigraphical Position of the Cherra Sandstone. Rec. G.S.I.*, 1940, **75** (4), 1.
3. Dutta, S. K., *The Laitryngew Coalfield and Its Exploitation. Min. Dev. in Assam Symp. Vol.*, 1964, p. 216.

RAPAKIVI STRUCTURE IN THE GRANITIC ROCKS OF ALMORA, U.P., INDIA

DURING the investigation of the granitic rocks of Almora area (79° 30' 50" E., 29° 36' 50" N.), the writers noted in them the presence of rapakivi structure. It is normally not observed megascopically but is brought out on staining with sodium cobalt nitrate and rhodizonate reagent (Bailey and Stevens, 1960¹). Under the microscope perthite porphyroblasts are, at times, seen to be surrounded and corroded by a polycrystalline rim of oligoclase grains. Quartz and mica also sometimes form a part of the rim. The oligoclase is untwinned and contains myrmekitic inclusions of vermicular quartz. It shows 2V between 84° (+ve) to 82° (+ve) corresponding to an anorthite content of 24-26%. The perthite is usually idiomorphic and in this respect differs from the characteristically ovoid potash feldspars of rapakivi granites from the type areas in

Scandinavia. It usually contains inclusions of the groundmass minerals, viz., earlier oligoclase, mica and quartz. From the evidence it is clear that oligoclase forms a replacement rim and the authors tentatively agree with Fernando (1941²) that the structure in the present case represents "an arrested stage in the replacement of potash with soda".

Department of Geology, K. B. POWAR.
Banaras Hindu University,
and

Centre of Advanced Study I. C. PANDE.
in Geology, Panjab University,
Chandigarh, April 30, 1966.

1. Bailey, E. H. and Stevens, R. E., *Amer. Min.*, 1960, 45, 1020.
2. Fernando, L. J. D., *Proc. Geol. Assoc.*, 1941, 52, 128.

A NEW SPECIES OF SPIDER OF THE GENUS *TRIAERIS* SIMON (FAMILY OONOPIDAE) FROM INDIA

THE spiders of the family Oonopidae are very little known from Indian fauna. The genus *Triæris* Simon, of the family Oonopidae is practically unknown from India.

While examining the spider collection from Shillong, I came across a new species of spider of the genus *Triæris*, which is described here.

The type specimen will in due course be deposited in the National Zoological Collections, Zoological Survey of India, Calcutta.

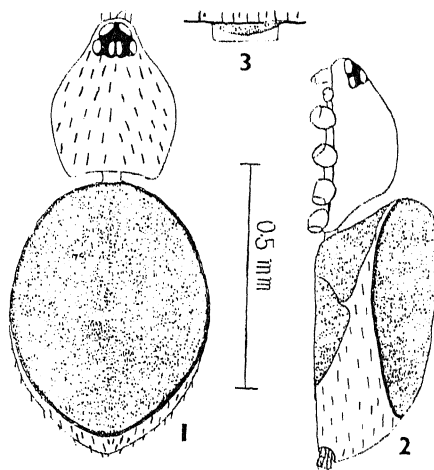
Triæris khashiensis Sp. Nov.

General.—Cephalothorax and abdomen reddish-brown, legs green. Total length 0.90 mm. Carapace 0.375 mm. long, 0.28 mm. wide; abdomen 0.625 mm. long, 0.47 mm. wide.

Cephalothorax.—Longer than wide, smooth, clothed with fine hairs, convex; cephalic region narrow and slightly high. Eyes six and pearly white arranged in two rows, anterior two eyes larger than others and remaining eyes nearly equal in size. Ocular area provided with conspicuous black patch. Clypeus moderate, margin of clypeus provided with five spine-like hairs, directed forward but middle one directed upward. Sternum heart-shaped, pointed behind, clothed with thick fine hairs. Labium nearly semicircular. Legs clothed with fine hairs and scanty spines. Patella of I very long and progressively shorter in II, III and IV. Patella I and II provided with three pairs of ventral spines; tibiae I and II with four pairs of ventral spines.

Abdomen.—Nearly elliptical clothed with fine hairs. Dorsal side (except a little portion of

the posterior side) provided with conspicuous scutum (Figs. 1 and 2) reddish-brown in colour but margin of scutum slightly darker than the remaining portion of scutum. Ventral side also provided with a scutum; extending from base to near the middle of abdomen. Epigyne as in Fig. 3.



FIGS. 1-3. Fig. 1. Dorsal view of female, legs omitted. Fig. 2. Lateral view of female, legs omitted. Fig. 3. Epigyne.

Holotype.—One female, **Paratype** nine females in spirit.

Type-Localities.—Botanical garden, Shillong, Assam, India. Coll. B. K. Tikader, 2-4-1966. **Paratype** locality Mawphlong ca 20 kilometres West of Shillong, Coll. B. K. Tikader, 12-4-1966.

This species resembles *Triæris stenaspis* Simon, but it is separated as follows: (i) Ventral abdominal scutum extending from base to near the middle of abdomen but in *T. stenaspis* ventral abdominal scutum small extending nearly posterior to the epigastric fold; (ii) Tibiae I and II provided with four pairs of ventral spines but in *T. stenaspis* tibiae I and II provided with five pairs of ventral spines.

Zoological Survey of India, B. K. TIKADER.
Eastern Regional Station,
Shillong-4 (India), April 18, 1966.

1. Comstock, J. H., *The Spider Book*, Revised and edited by Gertsch, W. J., New York, 1940, p. 309.
2. Locket, G. H. and Millidge, A. F., *British Spiders*, Ray Society, London, 1951, 1, 73.
3. Simon, E., *Histoire Naturelle des Araignées*, Paris, 1895, 1, 286.

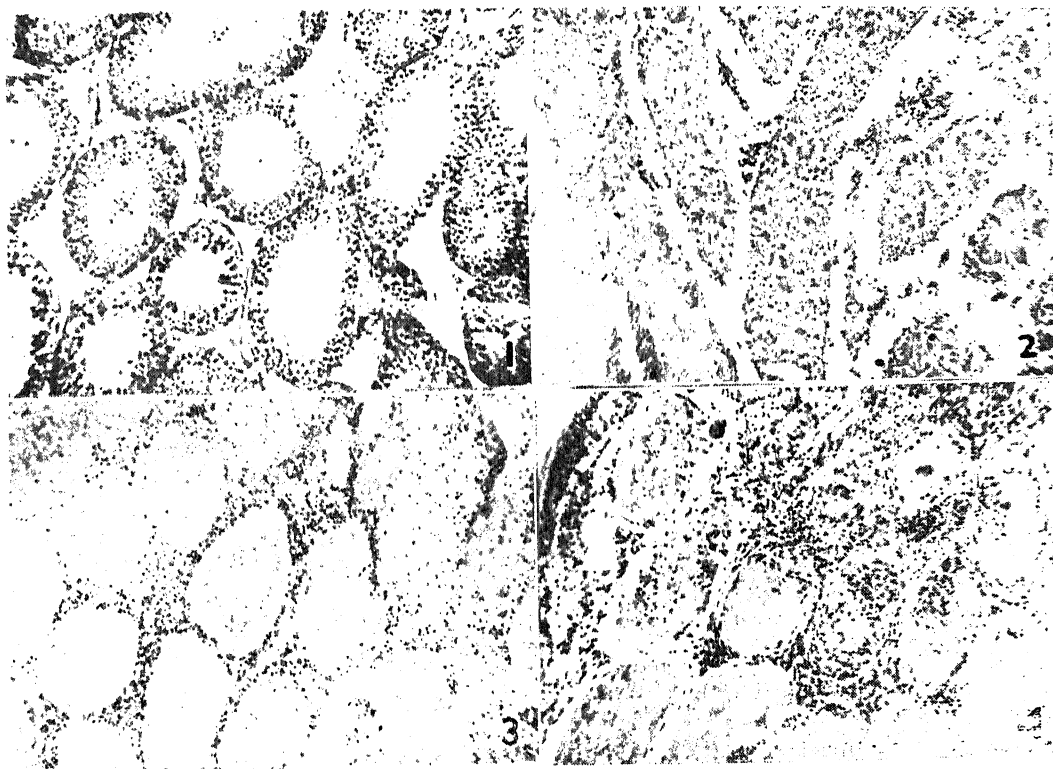
**EFFECT OF INTRATESTICULAR
ADMINISTRATION OF METOPIRON ON
THE TESTIS OF THE INDIAN DESERT
GERBIL *MERIONES HURRIANAE*
JERDON***

MANY chemicals are known to cause testicular necrosis and therefore its sterilization when they are administered subcutaneously or intratesticularly.¹⁻⁴ We wanted to find out if metopiron [2-methyl-1, 2-bis (3-pyridyl)-1-propanone; SU 4885, Ciba]† could be used towards this end; metopiron, in small doses, is known to inhibit 17-hydroxy-corticosterone secretion.⁵

Adult male gerbils receiving a total dose of 50 mg. of metopiron subcutaneously showed inhibition of spermiogenesis to various degrees.⁶ This prompted us to inquire if injection of metopiron ditartrate in smaller doses intratesticularly would destroy the testis tissue more effectively. So far as we know there is no report of metopiron being used as a sterilizing agent.

Normal adult male gerbils weighing 80-85 g. were selected and into each testis a single dose (10 mg.) of metopiron was injected. Control animals were injected intratesticularly the same volume of glass distilled water. The animals were sacrificed at two intervals: 48 hours, and 1 week after treatment.

Forty-eight hours after the administration of metopiron, the testis looked a hæmorrhagic mass and was weighing less than the control one. There was no reduction in the weights of the accessory reproductive organs, i.e., the seminal vesicles and prostate, and the bulbo-urethral glands. Histologically, metopiron caused a total necrosis of the testicular components (Fig. 2) when compared with the control (Fig. 1). The seminiferous tubules were left as an eosinophilic debris. The interstitial tissue was totally destroyed and the inter-tubular spaces showed hæmorrhagic blood. A week after the treatment, the colour of the testis changed to brown with bleached patches and there was greater reduction in the testis



FIGS. 1-4. Fig. 1. Photomicrograph of the testis of distilled water injected gerbil, $\times 100$. Fig. 2. Photomicrograph of the testis of metopiron injected (intratesticularly) gerbil showing a complete destruction of the seminiferous epithelium and the interstitium, $\times 100$. Fig. 3. Photomicrograph of gerbil testis one week after injection as above showing infiltration of leucocytes, $\times 100$. Fig. 4. Photomicrograph of gerbil testis one week after injection as above; note the proliferation of fibroblasts from the tunica, $\times 100$.

weight. The histology of the testis revealed the presence of leucocytes in the intertubular region and phagocytosis was noticed in the eosinophilic debris (Fig. 3). The tunica albuginea was thicker as compared with the control and there was proliferation of fibroblasts from it into the intertubular spaces (Fig. 4) indicating a regeneration of the interstitium. Appearance of new blood vessels was also noticed. The distilled water treated control testis remained consistently normal (see Fig. 1) but for exfoliation of sperm in some of the tubules.

The damage caused by a single intratesticular injection of metopiron to the gerbil is comparable with the action of many a chemical on the testis of various mammals. A single subcutaneous or intratesticular injection of cadmium chloride has been known to cause acute damage to the seminiferous epithelium and interstitium of various mammals including the gerbil.¹⁻³ In the gerbils reported now, the interstitium showed regeneration a week after the administration of the chemical as the fibroblasts from the tunica were probably being converted into Leydig cells as also reported by Kamboj and Kar⁴ in other animals after administration of certain metallic and rare-earth salts. A similar type of damage as described above was also observed by us in the gerbil testis after an intratesticular administration of Clomiphene, a non-steroidal synthetic compound.⁷

Details of the above experiments will be described elsewhere.

Reproduction Physiology D. K. KAUL.

Section, Dept. of Zoology, L. S. RAMASWAMI.
University of Rajasthan,
Jaipur, India, July 15, 1966.

* Investigation made possible by a grant from the Ford Foundation, New Delhi.

† We thank Messrs. Ciba Ltd., Basel, for gift of metopiron.

1. Parizek, J., *J. Reprod. Fertil.*, 1960, **1**, 1036.
2. Kar, A. B., *Acta Endocrinol.*, 1962, **40**, 257.
3. Ramaswami, L. S. and Kaul, D. K., *J. roy. micro. Soc.*, 1966, **85** (In press).
4. Kamboj, V. P. and Kar, A. B., *J. Reprod. Fertil.*, 1964, **7**, 21.
5. Liddle, G. W., Island, D., Lance, E. M. and Harris, A. P., *J. Clin. Endocrinol. and Metab.*, 1958, **18**, 906.
6. Unpublished data.
7. Unpublished data.

INTROGRESSION IN *PASPALIDIUM* STAPF

VARIATION in partially apomicts as described by Clausen¹ occurs frequently in grasses and is attributed primarily to chance hybridisation with a closely related parent. Recently, in North Bihar a small population of the genus *Paspalidium* Stapf was collected which on the basis of gross morphological data (Table I) could hardly be classified either under *P. flavidum* or *P. punctatum* and at the same time they do not contain a complete blend of the two species but most commonly, individuals which are more nearly like *P. flavidum* and contain certain characters or character combinations suggest *P. punctatum*. In geographic distribution the two seem to overlap and the characters selected are more variable in that part of the range of *P. flavidum* which coincides with the range of its relatives. Also the variation is in the direction of *P. punctatum*.

Apparently hybridisation followed by back crossing and selection of the back cross type have caused certain genes and gene combinations from *P. punctatum* to pass across the barrier separating the two species and to become incorporated into the genic complement of *P. flavidum*. Thus, this population on the basis of variation pattern shown in Table I represents a hybrid swarm as defined by Anderson.² Surprisingly on the other hand, morphological data for some of the plants are well within the range of the type description for *P. germinatum* and also these plants were collected from the marshy habitat. Furthermore, these are the only three species in *Paspalidium* known from Bihar³ or distributed in the adjoining geographical area.⁴ Be it so, then it puts in question the very origin of *P. germinatum*.

Cytologically, *P. flavidum* ($2n = 54$) and *P. punctatum* ($2n = 36$) have regular meiosis while the natural hybrids or the products of hybridisation ($2n = 45$) are irregular with chromosome association at metaphase I being upto $18 \text{ II} + 9 \text{ I}$ followed by unequal distribution of the chromosomes at the poles. Nine being the base number for the genus one might expect such cytological behaviour if the pairing of the 18 chromosomes is somewhat complete and the remaining 9 being left as univalents. However, the data available are not well enough to account for the real nature of pairing or chromosome homology among and of the two possible parents.

So far *P. germinatum* with $2n = 45$ is not known. However, on the basis of the introgressive population of *Paspalidium* species in

TABLE I
Morphological data

Characteristics	<i>P. flavidum</i>	<i>P. punctatum</i>	Natural hybrids
1. Inflorescence axis length (mm.)	.. 13.60 10.5-17.5	38.60 33.0-55.0	22.41 20.0-29.0
2. Total No. spike inflorescence	.. 5.75 4-7	12.40 10-14	10.10 6-17
3. Ratio Lower spike internode	.. 0.47 0.30-0.45	0.71 0.57-1.10	0.79 0.50-1.38
4. Rachis	.. 0-Produced	Produced	0-Produced
5. Upper lemma	.. Granular	Rugulose	Smooth
6. Upper glume	.. Not as long as upper lemma	1/2 length of upper lemma or more	As long as the upper lemma
7. Spikelets	.. Ovoid	Elliptical	Elliptical
8. 2"	.. 54	36	45

our collection an assumption is made for their occurrence in nature assuming chance hybridisation between *P. flavidum* and *P. punctatum* which seem to be closely related at least morphologically. As it has been reported recently in *Bothriochloa* and *Chloris*⁶ the intermediate type plants have very restricted distribution and show meiotic abnormalities but at the same time may set good seed possibly indicating the presence of apomixis. The latter phenomena, as in *Poa*,⁷ facilitates introgression which in turn may be expected to produce complex variation patterns. These ultimately become a taxonomic problem. Thus until sufficient experimental evidences become available such plants have been classified as suspected hybrids or hybrid derivatives of *P. flavidum* × *P. punctatum*. Specimens are in the herbarium of the Botany Department, Patna University.

Sincere thanks are expressed to Prof. R. P. Roy for providing the Laboratory facilities. Thanks are due also to the C.S.I.R., New Delhi, for financial assistance to the senior author.

Botany Department, A. P. SINGH,*
Patna University, D. N. SINGH.
Patna-5, April 18, 1966. F. AZAM.

* Present address: Assistant Botanist, Sugarcane Sub-station, Karnal, Punjab (India).

1. Clausen, J., *Caryologia* (Suppl. Vol.), 1954, 6, 499.
2. Andersson, E., *Introgressive Hybridisation*, Wiley & Sons, N.Y., 1949.
3. Haines, H. H., *The Botany of Bihar and Orissa*, Adlard & Sons, London, 1924.
4. Bor, N. L., *The Grasses of Burma, Ceylon, India and Pakistan*, Pergamon Press, Oxford, 1960.
5. Harlan, J. R., *Bot. Gaz.*, 1963, 124, 294.
6. Anderson, D., *Amer. Jour. Bot.* 1965, 52, 647.
7. Clausen, J., *Euphytica*, 1961, 10, 87.

DEVELOPMENT OF WHEAT AND BARLEY RUSTS ON SEEDLINGS TREATED WITH MALEIC HYDRAZIDE

INCREASE in the severity of many diseases like wilts, rusts and leaf-spots, due to the treatment of maleic hydrazide, has been reported by many workers.¹⁻⁴ Recently, Joshi⁵ studied the effect of the chemical on certain wheat and barley varieties and reported considerable increase in sporulation of leaf rust of barley (*Puccinia hordei* Oth) and stem rust of wheat [*P. graminis* var. *tritici* (Pers.) Erikss. and Henn.].

To study the effect of the chemical on resistant as well as susceptible varieties of wheat and barley seedlings were raised in 4" pots and 100-110 ml. of 0.02% maleic hydrazide was given as a soil drench at the time of emergence. The pots were not watered 12 hours before and 24 hours after the treatment. The seedlings were inoculated in the first leaf stage when they had fully unfolded, with freshly raised uredospore material of the different rusts. In a few cases secondary leaves were also inoculated. Barley seedlings were inoculated with *P. hordei* and wheat seedlings with *P. graminis* var. *tritici* and *P. recondita*. The inoculated seedlings were incubated in humid chamber for 48 hours and then transferred to glasshouse benches at a temperature range of 60-90° F. The work was carried out in the month of February/March in glasshouses where there was no temperature control devices and hence temperature fluctuations were very high. During daytime the temperature sometimes reached up to 90° F. or even slightly higher. Growth responses of the host as well as the changes in reaction type, if any, were recorded. Observations were recorded at least twice, usually on the 12th and 15th days after inocu-

lations. Experiments were repeated twice and the results are summarised in Table I.

TABLE I

Effect of maleic hydrazide on growth of certain wheat and barley varieties and their response to rusts

Name of variety	Inoculated with race 21 of <i>Puccinia graminis</i> var. <i>tritici</i>		
	Treated with 110 ml. of 0.02% maleic hydrazide		
	Rust reaction	Growth response	Control
Wheat ;			
Little club	8/8* 4++	Good	9/9 4
Marquis ..	10/10 4++	Very good	10/10 4
Reliance ..	8/8 0;	Fair	10/10 0
Einkorn ..	9/9 2 & 5 (Pustules without any necrosis)	Good	11/11 1-2
Vernal ..	9/9 2+	"	11/11 0; -1
Khapli ..	10/10 (First leaves showed 2 type pustules with brown necrosis but secondary leaves had 4 type pustules)	Very good	11/11 0; -1
Inoculated with race 20 of <i>Puccinia recondita</i>			
Agra local	13/13 4++	Very good	11/11 4
Mediterranean	8/8 0; -2 +	Fair	9/9 0; -1
Inoculated with race H ₂ of <i>Puccinia hordei</i>			
Treated with 100 ml. 0.02% maleic hydrazide			
Barley			
Chilean-D	12/12 4+	Good	10/10 4
Special ..	8/8 4++	"	11/11 4
Sudan ..	9/9 4	Fair	11/11 4
Etie ..	10/10 4++	Good	10/10 4
Gold ..	13/13 0; -1	Fair	9/9 0
Lechtaler	12/12 0	"	8/8 0

* The denominator indicates the number of leaves inoculated and the numerator the number of leaves infected. The figures against each give reaction types.

N.R.: No response. Growth as in control.

Fair: Secondary leaves approximately 1½ to 2 times longer than the first leaves. Darker in colour.

Good: Secondary leaves of the same size as the first leaves. Dark green in colour.

Very good: Secondary leaves practically suppressed or only 1 to 1½ long. Even first leaves show slight reduction.

From the data presented above it is evident that the change of a resistant reaction to a susceptible one was observed only in the case of the variety Einkorn and, to some extent, in

Khapli variety also. In the latter case, the susceptible reaction of only the second leaves is not clearly understood. For the remaining varieties it can be generalized that the susceptible varieties became more susceptible and exhibited profuse sporulation of all the three rusts tested. The resistant varieties tended to become less resistant, i.e., the highly resistant reactions (i. 0 or 1) changed to moderately resistant ones (1, 1 +, 2 or 1 +). The varieties did not behave in identical manner. In most of the varieties where growth response was more the rust reaction too showed significant change due to treatment. This, however, cannot be considered a rule and in certain cases, for instance in Sudan variety of barley, the growth response was fair but rust reaction did not show any change induced due to maleic hydrazide treatment.

Division of Mycology and L. M. JOSHI

Plant Pathology, I.A.R.I.,

New Delhi-12, April 21, 1966.

1. Simons, M. D., *Phytopathology*, 1955, **45**, 410.
2. Richards, L. T., *Canad. Journ. Plant Science* (Formerly *Canad. Journ. Agric. Sci.*), 1957, **37**, 196.
3. Samhorski, D. J. and Shaw, M., *Canad. Journ. Bot.*, 1957, **35**, 449.
4. Nair, P. N., *Phytopathology*, 1958, **48**, 288.
5. Joshi, L. M., *Indian Phytopath.*, 1965, **18**, 303.

BIOSYSTEMATICS AND ORIGIN OF THE INDIAN TETRAPLOID *SOLANUM NIGRUM* L.

It has been known since long that there exists a polyploid series within *Solanum nigrum* L. with plants having $n = 12$, 24 and 36 chromosomes.¹ Attempts have been made by several workers² to understand the nature of polyploidy and the probable mode of origin of tetraploids and hexaploids in this species. But none of these led to any definite conclusions. The taxonomic status of the naturally occurring tetraploid form of *S. nigrum* described so far from India by earlier workers^{2,4} is also not very clear. The present communication is a note on the origin of the Indian tetraploid *S. nigrum* and its taxonomic relationship with *S. luteum*.

The naturally occurring sympatric populations of *S. nigrum* at Delhi were classified mainly on the basis of fruit colour into three morphologically distinguishable forms. In type I, the fruits are shiny bluish-black, in type II, orange-red and in type III, purplish-black and larger than those of the types I and II. A microscopic study in the pollen mother cells from plants

representing types I, II and III showed them to be diploids ($n=12$), tetraploids ($n=24$) and hexaploids ($n=36$), respectively. Meiosis was normal in all these types with no multivalents or univalents.

To determine whether the naturally occurring tetraploid originated by spontaneous chromosome doubling of the diploid, autotetraploids were produced from the latter by colchicine treatment. The induced autotetraploid being an enlarged replica of the diploid resembled it in all characters including the colour of the berry.

A comparative morphological study of autotetraploids with naturally occurring tetraploids revealed that there are many differences between them which could not support the autopolyploid nature of the latter. Among the differences between their morphological characters the colour of the berry is worthy of mention. In natural tetraploid forms it was orange-red whereas in autotetraploids it was bluish-black as in the diploids. Cytologically autotetraploids differed from natural tetraploids. In autotetraploids meiosis was irregular and in majority of their pollen mother cells quadrivalents, bivalents and univalents were found in various combinations. Trivalents were also recorded at metaphase I, but in a very low frequency. Maximum number of quadrivalents and univalents was eight and six, respectively. At anaphase I, 28.25% of the pollen mother cells showed laggards. However, in naturally occurring tetraploids the meiosis was perfectly regular. Therefore, these morphological and cytological differences between them indicated their distant relationship. This has been further corroborated by the cytological behaviour of the hybrids between diploids and naturally occurring tetraploids. In triploids the gametic chromosome number was eighteen. They showed a wide range of meiotic irregularities. At diakinesis in majority of the pollen mother cells large number of univalents were observed together with loosely paired chromosomes into bivalents. Quite a good number of cells were also observed to have most of their chromosomes as univalents at metaphase I. Anaphase I was irregular and it was characterised by lagging univalents. No bridges and fragments were seen. Some of the cells showed micronuclei at telophase I. The pollen fertility was 0.25%.

The loose pairing of chromosomes into bivalents at diakinesis and the presence of a large number of chromosomes as univalents

during diakinesis and metaphase I in triploids indicated that the three genomes are not similar to each other. The chemistry of fruit colour of diploids and colchicine-induced tetraploids revealed that they contain anthocyanins; whereas in naturally occurring tetraploids the fruit colour is carotenoids. These chemical differences in the fruit pigments between colchicine-induced tetraploids and naturally occurring tetraploids also substantiated the conclusion based on morphological and cytological study that the naturally occurring tetraploids and autotetraploids are relatively independent in their origin. Even by assuming that the changes have occurred in the autotetraploids during the course of its evolution it is not likely that natural selection has caused such diverse changes.

A comparative study of the naturally occurring tetraploid *S. nigrum* and *S. luteum* showed that they resemble each other in general pattern of their morphological characters. In *S. luteum* the fruits are light orange-red in colour and in *S. nigrum* they are orange-red. The chemical analysis of fruit colour showed that the nature of pigment to be a carotenoid. Cytologically it was observed that in both species the gametic chromosome number is twenty-four and the meiosis is quite regular. Their genetic closeness has been further supported by the fact that they can be crossed readily producing fruits with viable seeds.

The karyomorphological studies, the identity of the chemical nature of the fruit colour and the ready crossability with each other have thus indicated that the tetraploid *S. nigrum* and *S. luteum* are closely related to each other. It is possible that the Indian tetraploid *S. nigrum* may be a geographical race of *S. luteum*. In the light of the abovementioned facts, it may be worthwhile for the taxonomists to review the systematic status of the tetraploid *Solanum nigrum* found in India.

Department of Botany,
University of Delhi,
Delhi-7, April 27, 1966.

S. L. TANDON.
G. R. RAO.*

* Department of Botany, Aligarh Muslim University, Aligarh.

1. Bhaduri, P. N., *J. Indian Bot. Soc.*, 1933, **12**, 56.
2. —, *Proc. 32nd Indian Sci. Congr. (Nagpur)*, 1945, Part III, p. 77.
3. Magoon, M. L., Ramanujam, S. and Cooper, D. C., *Caryologia*, 1962, **15**, 151.
4. Swaminathan, M. S., *Thesis*, A.I.A.R.I., New Delhi, 1949.

 REVIEWS AND NOTICES OF BOOKS

Classical Mechanics. By T. W. B. Kibble. (McGraw-Hill Publishing Company Ltd.), 1966. Pp. xv + 296. Price 42 sh.

This text-book is intended for use in the first or second year of an honours degree course in physics. Classical mechanics is treated as a branch of physics, rather than applied mathematics, and the emphasis of the book is on the basic principles involved, in particular those aspects which are of importance in the more advanced parts of the physics course, such as quantum mechanics, nuclear physics, and relativity.

The first half of the book is devoted to the basic principles of the subject and the mechanics of a single particle, while the second half deals with the mechanics of systems of particles and rigid bodies. The crucial role of the conservation laws is particularly stressed. The Lagrangian method is introduced in the third chapter and developed in later chapters. The last chapter contains a discussion of the Hamiltonian method, stressing the relationship between symmetries and conservation laws.

C. V. R.

Advances in Chromatography (Vol. I). Edited by J. Calvin Giddings and Roy A. Keller. (Marcel Dekker, Inc., New York), 1966. Pp. xv + 392. Price \$14.50.

It is clear that the individual worker, if he is to preserve even a moderate knowledge of the entire field, must rely more upon responsible literature surveys than on the attempt to read the avalanche of original research papers. The wealth of literature, even in specialized areas of chromatography, is so great that, for this series, noted authors have been asked to separate the hard core advances in each respective area from the overwhelming mass of supporting evidence and data. The authors have summarized and developed in a single paper their own ideas and expressed opinions of various facets or trends in research, putting their subject-matter in perspective. The series aims to promote information flow from country to country as well as among the specialists in the different branches of chromatography.

Volume I is dealt with in two parts, viz., General Chromatography and Gas Chromatography. Part one contains the follow-

ing chapters: Ion-Exchange Chromatography, by F. Helfferich; Chromatography and Electrophoresis on Paper and Thin Layers: a Teachers' Guide, by Ivor Smith; The Stationary Phase in Paper Chromatography, by George H. Stewart; The Techniques of Laminar Chromatography, by E. V. Truter; Part two contains the following chapters: Qualitative and Quantitative Aspects of the Separation of Steroids, by E. C. Horning and W. J. A. Vandenneuvel; Capillary Columns: Trials, Tribulations, and Triumphs, by D. H. Desty; Gas Chromatographic Characterization of Organic Substances in the Retention Index System, by E. sz. Kovats; Inorganic Gas Chromatography, by Richard S. Juvet, Jr. and Franjo Zado; Lightly Loaded Columns, by Barry L. Karger and W. D. Cooke; Interactions of the Solute with the Liquid Phase, by Daniel E. Martire and Luigi Z. Pollara. C. V. R.

Atomic Absorption Spectroscopy. By James W. Robinson. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1966. Pp. xi + 204. Price \$9.75.

Atomic absorption spectroscopy is an analytical process based on the absorption of radiant energy by atoms. This book presents an objective appraisal of the subject and covers all the essential features. Particular attention is paid to the chemistry and physics involved in the atomization and the absorption process, and to the equipment used for this work. Finally, analytical applications are discussed in adequate detail for the practising analytical chemist. This book will be useful to the graduate student in analytical chemistry, the research chemist who wishes to know "if" and "how" the method is applicable to solving his problem, and the analytical chemist responsible for providing rapid and accurate analyses for research and industry.

The titles of the chapters contained in this book are as follows: (i) Introduction; (ii) Equipment; (iii) Analytical Parameters; (iv) Analytical Applications; V. Topics Related to Atomic Absorption: Oscillator Strength, Vacuum Ultra-violet, and Atomic Fluorescence.

C. V. R.

Physical Techniques in Biological Research (Second Edition) (Vol. III A)—*Cells and Tissues*. (Academic Press, New York and London), 1966. Pp. xii + 408. Price \$ 13.50.

Since the publication of the first edition of this volume, there have been many improvements and innovations in physical techniques used in biological research on cells and tissues. These advances and refinements have led to the necessity of publishing a second edition. In this new edition, all subject-matter has been revised and brought up-to-date although the original organization of the material has been retained. Volume III has been divided into two sections, III A and III B, for greater ease in handling the increased amount of material.

The present volume under review contains the following chapters: 1. Phase Contrast and Interference Microscopy in Cytology, by R. Barer; 2. Birefringence and Dichroism of Cells and Tissue, by Fritz Ruch; 3. X-Ray Microscopy and X-Ray Absorption Analysis, by Arne Engstrom; 4. Microtomy, by Allen W. Wachtel, Mark E. Gettner and Leonard Ornstein; 5. Manometric Techniques for Single Cells, by H. Holter and E. Zeuthen; 6. Electron Microscopy of Micro-organisms, by Thomas F. Anderson.
C. V. R.

Poisonous Plants of India. By R. N. Chopra, R. L. Badhwar and S. Ghosh. (Published by the Indian Council of Agricultural Research, New Delhi). Vol. 1: Pp. xx + 631. Price Rs. 32.00; Vol. 2: Pp. 633-972. Price Rs. 20.50.

In the economy of an essentially agricultural country like India poisonous plants also play an important role. Although in general they are a menace to life and bodily functions of man and animals, many of them have proved to be sources of potent remedies for particular types of diseases afflicting men and animals. Some of them while poisonous to insects are comparatively harmless to man. Such plants are valuable to fight against insect pests. It is therefore of fundamental importance to any country to undertake systematic work on these plants to gain knowledge of their distribution, chemical constituents, and physiological action. There is an increasing tempo of research along these directions going on in this country, and the present publication, a revised and augmented two-volume edition of the well-known original book by Dr. Chopra and his colleagues which is not easily available now, fulfils a much-needed want.

Dr. Chopra and his colleagues were responsible for researches and compilation of data on poisonous plants of India, and the first edition was published in 1949 as a Monograph (No. 17) of the Indian Council of Agricultural Research. The first volume of the present second edition is a revised edition of the Monograph made more up to date, and contains, besides, ten new species, two of them belonging to new genera.

The second volume is entirely new and includes about 110 genera, belonging to 34 families. The presentation follows the same plan as in the first, giving under each plant the botanical characteristics, geographical distribution, uses and properties, and constituents and toxicity. In most cases there is an illustration of the plant also.

There is no doubt that the twin-volumes will remain a standard reference work on the subject for some years to come.
A. S. G.

The Indian Ephemeris and Nautical Almanac for the Year 1967. (Published by the Manager of Publications, Civil Lines, Delhi-6). Pp. xviii + 464. Price Rs. 14 or 32 sh. 8d. or \$ 5.04.

The present annual volume of the Indian Ephemeris for 1967 is the tenth in this series, the first of which for the year 1958 was issued in 1957. It follows the same pattern as the previous volume and gives the positions of the celestial bodies calculated according to the *Ephemeris Time*, which is slightly different from the Universal or Greenwich Mean Time.

A section of special interest is the one on Indian Calendar (pp. 387-436) prepared according to the recommendations of the Calendar Reform Committee, which furnishes much useful information to meet the requirements of the *Panchanga* compilers in the country. It is to be noted that the tables of this section have been extended to include data up to March 21, 1968 so as to facilitate preparation of Indian almanacs for the complete Indian year 1889 Saka.
A. S. G.

Announcements

Aflatoxin Research in Malaysia

Research in progress at several institutions in Kuala Lumpur has shown that aflatoxin is sometimes present in various groundnut products on sale in Malaysia. In view of the social implications and the need for an interdisciplinary approach to them the Malaysian Scientific Association has set up a committee with the

following terms of references: "To encourage investigation of aflatoxine in Malaysia and to collect and disseminate information on this problem. To formulate recommendations for the reduction of hazards arising from aflatoxine in this country".

The committee includes or is in touch with all persons known to be engaged on aflatoxin research in Malaysia: it welcomes relevant correspondence from any source: G. F. J. Moir, Chairman, Aflatoxin Committee, The Malaysian Scientific Association, P.O. Box 911, Kuala Lumpur, Malaysia.

Symposium on "Indian Ocean"

A Symposium on "Indian Ocean" jointly sponsored by the Indian National Committee on Oceanic Research and the National Institute of Sciences of India, will be held from March 2 to 4, 1967 at the National Institute of Sciences of India, Bahadur Shah Safar Marg, New Delhi. The object of the Symposium is to discuss the scientific results of the International Indian Ocean Expedition, 1960-65. There will be group discussions on Physical and Chemical Oceanography, Geology and Geophysics, Biology including fisheries and marine meteorology. Those who wish to contribute papers for the Symposium are requested to communicate immediately their names and titles of papers to the Convener of the Symposium, Dr. N. K. Panikkar, Director, National Institute of Oceanography, CSIR, Rafi Marg, New Delhi-1, India. Abstracts of papers for printing may be sent so as to reach Convener not later than January 31, 1967.

International Symposium on Conformation of Biopolymers

This Symposium sponsored by the International Union of Pure and Applied Biophysics is being organized at the University of Madras, Centre of Advanced Study in Biophysics, from January 18 to 21, 1967 and will be presided over by Professor Linus Pauling.

The main scope of the Symposium will be the structure of biological large molecules with special reference to its conformational aspects. Thus, the Symposium will deal with the molecular structure of proteins, nucleic acids and polysaccharides investigated by optical, X-ray, Infra-red and other methods. There will also be some papers dealing with the relationship of chemical structure to biological activity.

The participation in the Symposium is by invitation. However, those interested in

attending the Symposium as delegates are welcome and they are requested to write to the Secretary, Dr. C. Ramakrishnan, Centre of Advanced Study in Biophysics, University of Madras, A.C. College Buildings, Madras-25, for necessary details and application forms.

Award of Research Degrees

Andhra University has awarded the following degrees: Ph.D. in Physics to Shri C. Krishna Murty and Shri K. Narasimha Murty for their theses entitled "Ultrasonic Absorption in Solution of Cerous, Lanthanum and Zinc Acetates" and "Studies on Internal Bremsstrahlung Accompanying Beta Decay" respectively. Ph.D. degree in Chemistry to: Shri P. Pentayya Naidu for his thesis entitled "On Some Uses of Permanganometry"; Shri T. P. Prasad for his thesis entitled "Precipitation of Beryllium from Homogeneous Solution"; Shri T. Sundararamaiah for his thesis entitled "A Chemical Study of Triterpenoids from Heart Woods". Ph.D. degree in Botany to Shri P. S. Prakasa Rao for his thesis entitled "A Contribution to the Embryology, Floral Anatomy and Wood Anatomy of the Family Combretaceae".

Patna University has awarded the Ph.D. degree in Zoology to Miss Nirmala Chatterjee for her thesis entitled "Studies on the Nutrition of the Growing Oocytes of Selected Vertebrates".

Sri Venkateswara University has awarded the Ph.D. degree in Zoology to Shri Y. Surendranath Reddy for his thesis entitled "Cellular Charge Patterns in Cells and Their Relation to Metabolism".

Utkal University has awarded the Ph.D. degree in Physics to Shri B. B. Banerjee for his thesis entitled "Dynamics of Vibration of a Cantilever under Lateral Impact of an Elastic Load".

Books Received

Administration and Financing of Irrigation Works in India. By N. D. Gulhati. (Central Board of Irrigation and Power, New Delhi-1), 1965. Pp. vi + 104.

Fluidization and Related Processes—A Symposium. (Publication and Information Directorate, C.S.I.R., New Delhi), 1966. Pp. 271. Price Rs. 24-00.

The Indian Journal of Genetics and Plant Breeding—The Impact of Mendellism on Agriculture Biology and Medicine. Edited by S. Ramanujam. (Indian Society of Genetics and Plant Breeding, I.A.R.I., New Delhi-12), 1965. Pp. xxii + 485. Price Rs. 30-00.

CRYSTALLOGRAPHIC DATA FOR SOME AMINO ACIDS, DIPEPTIDES AND RELATED COMPOUNDS*

K. K. CHACKO, R. CHANDRASEKHARAN, MRS. GODAVARI CHANDRASEKHARAN,**
A. R. KALYANARAMAN, M. MALLIKARJUNAN, R. RAMACHANDRA AYYAR,
M. N. SABESAN, T. SRIKRISHNAN, R. SRINIVASAN, E. SUBRAMANIAN,
S. THYAGARAJA RAO AND K. VENKATESAN

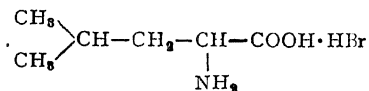
Centre of Advanced Study in Physics, University of Madras, Madras-25, India

WE present here preliminary crystallographic data for some amino acids, dipeptides and related compounds. The X-ray analysis of the structure of such compounds has been a long-term project at this Centre as part of a major programme on the structure of proteins and other related biomolecular substances. The data presented here pertain mainly to the determination of the unit cell dimensions and space group. The compounds reported here are: (1) L-leucine hydrobromide; (2) L-tryptophan hydrobromide; (3) DL-ornithine hydrobromide; (4) L-ornithine hydrochloride; (5) DL-histidine dihydrochloride; (6) DL-valine; (7) N-methyl-DL-leucyl glycine hydrobromide; (8) L-threonyl *p*-nitrobenzyl ester hydrobromide; (9) L-prolyl-L-phenylalanine O-methoxy hydrobromide; (10) L-prolyl-L-phenylalanine O-benzyl hydrobromide; (11) γ -L-glutamyl-L-methionine; (12) Chloroacetyl glycy glycine; (13) Phenylenediamine dihydrochloride; (14) 1-amino cyclopentane carboxylic acid hydrobromide; (15) 1-amino cycloheptane carboxylic acid hydrobromide; and (16) 1-amino cyclo octane carboxylic acid hydrobromide. Of these compounds (1) to (6) are amino acid derivatives while (7) to (12) are dipeptide derivatives. The interest in compound (13) is that it has amino groups. Recently, much valuable information has been gleaned by a systematic study of the conformation of amino acids and other simple peptides (e.g., Ramachandran *et al.*, 1966). It would also be of interest to obtain information about the conformation of related molecules containing amino and carboxylate groups under various other conditions and environments. It was for this reason the last three compounds (14) to (16) were also taken up which are cyclic compounds containing amino and carboxylate groups.

The structure in all essential details has been established for the compounds L-leucine hydrobromide, L-tryptophan hydrobromide, phenylenediamine dihydrochloride and L-threonyl-L-phenylalanine *p*-nitrobenzyl ester hydrobromide. The detailed reports of these will be published separately. The others are in various stages of analysis. A short description with regard to each compound is given below. Table I gives the crystallographic data. Unless otherwise stated, the determination of cell parameters was carried out mostly using Weissenberg and Precession photographs. The radiation used was CuK_α .

1. L-LEUCINE HYDROBROMIDE

The chemical formula of this compound is



Crystals were obtained by dissolving L-leucine in 30% hydrobromic acid and allowing the solution to evaporate at room temperature. The crystals were soft and hygroscopic and decomposed quickly on exposure to air. The crystal had to be sealed in Lindemann tube. The only systematic absences noticed were $h\ 0\ 0$ reflections, h odd absent; $0\ k\ 0$, k odd absent and $0\ 0\ l$, l odd absent. The space group was uniquely fixed as $P2_12_12_1$.

The structure was solved by the heavy atom method. The co-ordinates of the bromine atom were determined from the projection data along the *c*- and *a*-axes. The *x* co-ordinate of bromine turned out to be close to 0.25 which resulted in practically no contribution from the bromine atom to reflections of the type $h + k = 2n + 1$. Direct sign determining method was used to determine the signs of these reflections, where the signs determined for other reflections for bromine contribution were made use of. The structure was refined using three-dimensional data and the least square technique.

* Contribution No. 201 from the Centre of Advanced Study in Physics, University of Madras, Madras-25.

** Deceased.

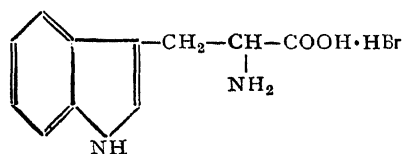
TABLE I
Crystallographic data

Sl. No.	Name	Formula	$a(\text{\AA})$	$b(\text{\AA})$	$c(\text{\AA})$	$\alpha(^{\circ})$	$\beta(^{\circ})$	$\gamma(^{\circ})$	$V(\text{\AA}^3)$	ρ obs., gm./c.c.	Z	Molecular weight cal- culated	Molecular formula weight	Space group
1	L-Leucine hydrobromide	$C_6H_{13}NO_2 \cdot HBr$	7.29	24.51	5.54	..	..	..	989.9	1.42 ₃	4	210.5	212.0	$P2_12_12_1$
2	L-Tryptophan hydrobromide	$C_{11}H_{12}N_2O_2 \cdot HBr$	14.56	5.44	7.57	..	100.50	..	591.9	1.58 ₂	2	282.0	285.0	$P2_1$
3	DL-Ornithine hydrobromide	$C_5H_{12}N_2O_3 \cdot HBr$	9.39	7.90	11.66	..	109.83	..	813.6	1.74 ₇	4	213.9	213.0	$P2_1/c$
4	L-Ornithine hydrochloride	$C_5H_{12}N_2O_3 \cdot HCl$	5.02	8.03	10.05	..	97.05	..	402.1	1.35 ₀	2	163.5	168.0	$P2_1$
5	DL-Histidine dihydrochloride	$C_6H_9N_3O_2 \cdot 2HCl$	8.38	15.42	8.81	..	113.55	..	1043.5	1.48 ₇	4	230.7	228.0	$P2_1/c$
6	DL-Valine	$C_5H_{11}NO_2$	5.20	22.12	5.41	..	109.03	..	587.8	1.32 ₀	4	116.2	117.0	$P2_1/c$
7	N-Methyl-leucyl glycine hydrobromide	$C_9H_{18}N_2O_3 \cdot HBr$	17.21	17.80	8.41	..	..	..	2576.3	1.47 ₂	8	283.3	283.0	$Pbca$
8	L-Threonyl-L-phenylalanine- <i>p</i> -nitrobenzyl ester hydrobromide	$C_{26}H_{35}N_3O_6 \cdot HBr$	8.93	45.75	5.05	..	..	..	2063.2	1.60 ₆	4	497.6	484.0*	$P2_12_12_1$
9	L-Prolyl-L-phenylalanine-O-methoxy hydrobromide	$C_{15}H_{20}N_2O_5 \cdot HBr$	13.41	6.75	9.43	..	103.5	..	830.0	1.41 ₀	2	352.9	357.0	$P2_1$
10	L-Prolyl-L-phenylalanine-O-benzyl hydrobromide	$C_{20}H_{25}N_2O_3 \cdot HBr$	5.34	9.94	43.22	..	..	..	2294.1	1.36 ₀	4	470.3	419.0†	$P2_12_12_1$
11	γ -L-Glutamyl-L-methionine	$C_{10}H_{18}N_2O_5 \cdot H_2S$	5.09	9.83	26.56	..	..	..	1328.9	1.42 ₀	4	284.5	278.0	$P2_12_12_1$
12	Chloroacetyl glycylglycine	$C_6H_9ClN_2O_4$	21.30	4.81	9.30	..	114.6	..	865.0	1.57 ₀	4	203.3	208.0	$P2_1/a$
13	Phenylenediamine dihydrochloride	$C_6H_8N_2 \cdot 2HCl$	8.75	5.37	4.34	99.78	95.57	111.17	201.4	1.50 ₈	1	181.4	181.0	$P\bar{1}$
14	1-Aminocyclopentane carboxylic acid hydrobromide	$C_6H_{11}NO_2 \cdot HBr$	10.53	6.08	7.04	..	99.67	..	446.3	1.62 ₀	2	216.1	210.0	$P2_1$
15	1-Aminocycloheptane carboxylic acid hydrobromide	$C_8H_{15}NO_2 \cdot HBr$	25.69	6.85	6.61	..	..	..	1162.3	1.47 ₄	4	256.2	238.0†	$P2_12_12_1$
16	1-Aminocyclooctane carboxylic acid hydrobromide	$C_9H_{17}NO_2 \cdot HBr$	26.40	7.09	6.16	..	..	..	1153.0	1.47 ₃	4	253.8	252.0	$P2_12_12_1$

* See text; † Indicates possibility of three water molecules in the asymmetric unit; ‡ Indicates possibility of one water molecule in the asymmetric unit.

2. L-TRYPTOPHAN HYDROBROMIDE

The chemical formula of this is

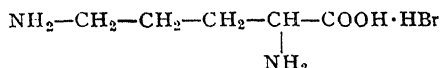


Crystals were prepared by dissolving L-tryptophan in hydrobromic acid and slowly evaporating the solution. The only systematic absences noticed were 0 *k* 0 reflections, *k* odd absent. The space group was thus fixed uniquely as $P2_1$. The structure was determined by the usual heavy atom method, first locating the heavy atom using projection data. Refinement

of the structure using three-dimensional data is in progress.

3. DL-ORNITHINE HYDROBROMIDE

The chemical formula of this compound is



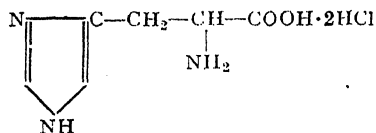
Crystals were obtained, as colourless needles, from aqueous solution by slow evaporation. The systematic absences were $h\ 0\ l$ reflections with l odd absent and $0\ k\ 0$ reflections k odd absent. Thus, the space group was uniquely fixed to be $P2_1/c$. The structure has been determined in the c projection and the three-dimensional work is in progress.

4. L-ORNITHINE HYDROCHLORIDE

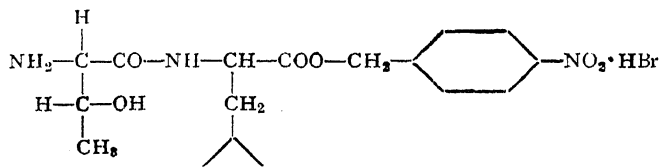
The amino acid here is the same as in the previous one excepting that this is a hydrochloride derivative and an optically active form. Crystals were obtained from aqueous solution at room temperature. The crystal was found to belong to the monoclinic system with the needle as the non-unique axis (a). The only systematic absences were $0\ k\ 0$, k odd absent. The space group was thus fixed to be $P2_1$.

5. DL-HISTIDINE DIHYDROCHLORIDE

The chemical formula is

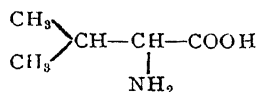


The crystals were obtained, with considerable difficulty by varying the conditions of crystallization. Small elongated crystals having bipyramidal shape were obtained. The system was found to be monoclinic. The systematic absences were $0\ k\ 0$, k odd absent and $h\ 0\ l$, l odd absent. The space group was thus fixed to be $P2_1/c$.



6. DL-VALINE

The chemical formula is

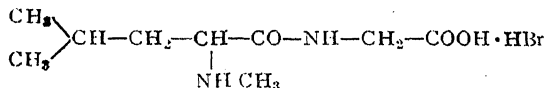


Crystals were picked from commercially available sample of DL-valine. The crystal was found to belong to the monoclinic system and the systematic absences were $0\ k\ 0$ reflections, k odd absent and $h\ 0\ l$, l odd absent. These fixed the space group uniquely as $P2_1/c$.

Albrecht *et al.* (1943) reported the cell dimensions of this compound which are in essential agreement with our preliminary measurements. However, their assignment of the space group as $P2_1$ with two molecules in the asymmetric unit seems to be erroneous. Dawson *et al.* (1951) reported the cell dimensions and space group of a triclinic modification of this compound.

7. N-METHYL-DL-LEUCYL GLYCINE HYDROBROMIDE

The chemical formula is



The crystal belongs to the orthorhombic system. The systematic absences were $0\ k\ l$, k odd absent, $h\ 0\ l$, l odd absent, $h\ k\ 0$, h odd absent. The space group was thus fixed to be $Pbca$. The position of bromine atom has been determined from projections and the structure determination using three-dimensional data is in progress.

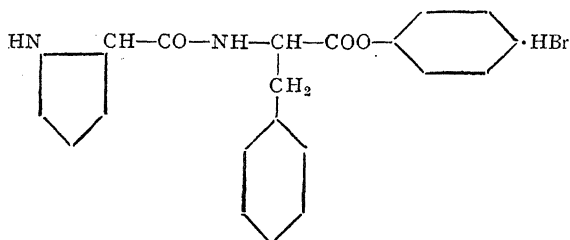
8. L-THREONYL-L-PHENYLALANINE *p*-NITRO-BENZYL ESTER HYDROBROMIDE

The chemical formula is

The crystals were obtained in the form of thin needles elongated along the *c*-axis by evaporating an aqueous solution at 45° C. The crystal belongs to the orthorhombic system.

10. L-PROLYL-L-PHENYLALANINE-O-BENZYL HYDROBROMIDE

The chemical formula is

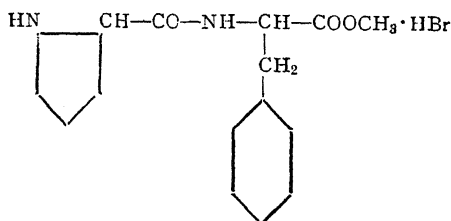


From systematic absences the space group was fixed to be $P2_12_12_1$. The density, measured by flotation, was 1.60 gm./cm.³ Assuming four molecules in the unit cell the calculated molecular weight was found to be 497.6, the value corresponding with the chemical formula being 484.

The structure was determined *via* the heavy atom method and refinement by the Least-Squares method, using three-dimensional intensity data was carried out upto an *R*-value of 13.7%. The three-dimensional difference Fourier map calculated was almost featureless and did not provide any evidence for the existence of a water of crystallisation as may be suspected by molecular weight calculations.

9. L-PROLYL-L-PHENYLALANINE-O-METHOXY HYDROBROMIDE

The chemical formula is

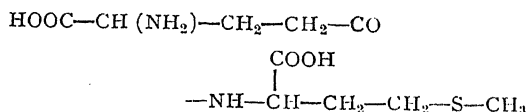


The crystals were platelike in shape elongated along the *b*-axis; *c** was normal to the principal faces of the plates. The crystal belongs to the monoclinic system. The only systematic absences were 0 *k* 0, *k* odd absent, which indicated that the space group is $P2_1$. The density, measured by flotation, was 1.41 gm./c.c. and the calculated density was 1.43 gm./c.c., assuming two molecules per unit cell. The position of bromine atom has been determined in the *b*-axis Patterson projection. The determination of the structure in projection down the *b*-axis is in progress.

The crystals were in the form of thin needles elongated along the *a*-axis. The crystal belongs to the orthorhombic system. From systematic absences, the space group was fixed to be $P2_12_12_1$. The density measured by flotation was 1.36 gm./cm.³ With four molecules in the unit cell, the calculated molecular weight of the crystallographic asymmetric unit was 470.3. The value corresponding with the chemical formula was 419. The difference suggests presence of three water molecules in the asymmetric unit. The crystals were hygroscopic and were sealed in Lindemann capillary tubes during photography.

11. γ-L-GLUTAMYL-L-METHIONINE

The chemical formula is



The compound isolated from the bulbs of onion (*Allium cepa*) was kindly sent by Professor A. I. Virtanen. Colourless thin plate-like crystals were recrystallized from acetone-water solution. The crystals were found to be orthorhombic and from systematic absences the space group was fixed to be $P2_12_12_1$, with four molecules in the unit cell.

12. CHLOROACETYL GLYCYL GLYCINE

The chemical formula is

$\text{Cl}-\text{CH}_2-\text{CO}-\text{NH}-\text{CH}_2-\text{CO}-\text{NH}-\text{CH}_2-\text{COOH}$
Needle-shaped crystals were obtained by evaporating an aqueous solution of the commercially available sample at 40° C. They were elongated along the *b*-axis. Rotation and Weissenberg photographs showed the system to be monoclinic. The density measured by the method of flotation was 1.57 gm./c.c. The systematic absences were 0 *k* 0 reflections, *k* odd and *h* 0 *l*, *l* odd absent. Thus, the space group was fixed to be $P2_1/c$.

13. PHENYLENEDIAMINE DIHYDROCHLORIDE

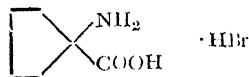
The chemical formula is



Good crystals were picked from commercially available pure sample. The crystal had to be sealed in Lindemann tube since it decomposed on exposure to air. The crystal was found to belong to the triclinic system, with one molecule per unit cell. Since the molecule has a centre of symmetry the space group was assumed to be $P\bar{1}$ with half the molecule constituting the asymmetric unit. The structure was determined in projection and refinement using three-dimensional data is in progress.

14. 1-AMINO-CYCLOPENTANE CARBOXYLIC ACID HYDROBROMIDE

The chemical formula is

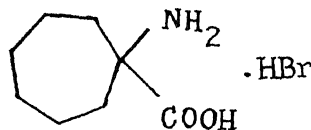


Samples of this and the heptane (15) and octane (16) derivatives described below were kindly supplied by Dr. R. Zand of the University of Michigan. The crystals were found to be needle-shaped.

The system was found to be monoclinic with b as the needle axis. The only systematic absences were $0\ k\ 0$ reflections, k odd absent. There are two molecules in the unit cell. The space group was thus assigned to be $P2_1$. The space group $P2_1/m$ seems to be improbable since this would demand that the molecule and the bromine atom should lie on symmetry plane which is too severe a restriction as seen from the nature of the formula. In fact, the structure in one projection namely along b -axis has been established, by first locating the bromine atom from the Patterson function.

15. 1-AMINO-CYCLOPENTANE CARBOXYLIC ACID HYDROBROMIDE

The chemical formula is

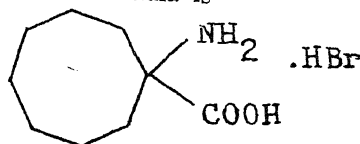


The crystals were thick and flaky in shape. The system was found to be orthorhombic. Systematic absences were $h\ 0\ 0$ reflections, h odd absent; $0\ k\ 0$, k odd absent and $0\ 0\ l$, l odd absent. The space group was fixed to be $P2_12_12_1$. The calculated value of molecular weight assuming $Z=4$ gave 256 while the

expected formula weight was 238. The difference thus suggested presence of one water molecule per asymmetric unit.

16. 1-AMINO-CYCLOOCTANE CARBOXYLIC ACID HYDROBROMIDE

The chemical formula is



The crystals were needle-shaped and colourless. Systematic absences were $h\ 0\ 0$ reflections, h odd absent; $0\ k\ 0$, k odd absent and $0\ 0\ l$, l odd absent. The space group was fixed to be $P2_12_12_1$, with four formula units in the unit cell.

It may be noticed in particular that the cycloheptane and cyclooctane derivatives have unit cell dimensions which are rather close. The space groups also suggest that they are possibly isomorphous. The volume of the unit cell of the heptane derivative is $1162\ \text{\AA}^3$, while that of the octane derivative is $1157\ \text{\AA}^3$. The one CH_2 group that is less in the heptane compared to the octane one, appears to have been compensated by the presence of one water molecule in the former. These require full confirmation by actual structure analysis.

A better assessment of the possible isomorphism between the two crystals would be to use the statistical methods (Ramachandran *et al.*, 1963; Srinivasan *et al.*, 1963). These are to be made after intensity data become available and will be reported in due course.

We wish to record our thanks to Professor G. N. Ramachandran for his interest in the work. Thanks are due to Professor S. Akabori and Dr. S. Sakakibara of the Institute of Protein Research, Osaka, for supplying samples of compound (8); to Professor E. Havinga, Rijksuniversiteit, Leiden, for sending us compounds (9) and (10); to Professor A. I. Virtanen, Biochemical Institute, Helsinki, for giving samples of (11) and to Dr. R. Zand of the Biophysics Research Division, University of Michigan, for kindly supplying samples of the compounds (14), (15) and (16).

1. Albrecht, G., Schnakenberg, G. W., Dunn, M. S., and McCullough, J. D., *J. Phys. Chem.*, 1943, **47**, 24.
2. Dawson, G. and Mathieson, A. McL., *Acta Cryst.*, 1951, **4**, 475.
3. Ramachandran, G. N., Mazumdar, S. K., Venkatesan, K. and Lakshminarayanan, A. V., *J. Biol. Biol.*, 1966, **15**, 232.
4. —, Srinivasan, R. and Raghupathy Sarma, V., *Acta Cryst.*, 1963, **16**, 662.
5. Srinivasan, R., Raghupathy Sarma, V. and Ramachandran, G. N., In *Crystallography and Crystal Perfection*, Ed. G. N. Ramachandran, Academic Press, London, 1963, p. 85.

INITIAL SUSCEPTIBILITY AND CONSTRICTED RAYLEIGH LOOPS OF SOME
BASALTS

S. D. LIKHITE AND C. RADHAKRISHNAMURTY

Tata Institute of Fundamental Research, Colaba, Bombay-5

INTRODUCTION.

A KNOWLEDGE of the magnetic susceptibility of rocks in a weak field of about 0.5 Oe is a prerequisite for the overall interpretation of the anomalies obtained in the magnetic surveys. The measurement of susceptibility in such low fields by D.C. methods is rather difficult and A.C. methods are therefore generally used. However, measurement by A.C. methods will yield correct values only if the applied peak magnetic field is well within the range of the initial susceptibility, i.e., if the susceptibility is constant up to the maximum field used. It is known that at least for some rocks the susceptibility changes with the field even at such low values of the field, whereas for others it is constant even up to fields of about 20 Oe. It is thus necessary to know the range of initial susceptibility for rocks which according to Nagata¹ requires a more thorough investigation in spite of the experimental difficulties involved.

It has been found that some rocks show hysteresis phenomenon in fields which are comparatively much lower than their coercive force. The low field hysteresis loops are known as Rayleigh loops and obey the empirical laws deduced by Lord Rayleigh.² Since the coercive force for rocks ranges from a few tens to as much as 400 Oe, one would expect to get Rayleigh loops in fields between 1 and 10 Oe. Studies on rocks in the Rayleigh region can also give valuable information regarding their general magnetic behaviour as suggested by Neel.³

We have recently made detailed investigations on the range of the initial susceptibility and the Rayleigh loops of over a hundred basaltic specimens. The most important phenomenon observed was that quite a good number of rocks showed constricted Rayleigh loops.

EXPERIMENTAL ARRANGEMENT AND PROCEDURE

The susceptibility apparatus described by us⁴ earlier has been modified so that the low field hysteresis loops could be displayed directly on an oscilloscope screen. The apparatus essentially consists of a pair of Helmholtz Coils by which an alternating magnetic field of any frequency from 20 to 2,000 cps. could be obtained

by feeding the coils from an audio-frequency oscillator and a high quality amplifier combination. At the centre of this pair of coils is a double coil which can be balanced to a very high degree at any frequency in the above-mentioned range. Under the influence of the energizing field, the specimen, which is placed inside the double coil, behaves like an alternating dipole and induces in the double coil a differential emf which is proportional to the rate of change of magnetic moment. This signal after suitable integration and amplification is proportional to the magnetic moment of the specimen and is applied to the vertical plates of the oscilloscope.

The emf across a small resistance in series with the Helmholtz coils circuit, which is proportional to the magnetic field produced by them, is fed after suitable amplification and phase correction to the horizontal plates of the oscilloscope.

In the experimental procedure the magnetic field is increased to the desired peak value and the double coil is balanced, this gives a 'scope trace which is a perfect horizontal line. Then the specimen is kept inside the double coil. Now, if the specimen exhibits hysteresis phenomenon in the applied peak field, the trace will expand into a loop, and if it does not then the line will be tilted with respect to the horizontal.

In our set-up the balance of the double coil is so nice that the 'scope trace remains a horizontal line, only increasing in length, as the field is increased. This permits the gradual increasing of the field and behaviour of the specimen can thus be studied continuously in the desired range of the applied field.

RESULTS

We have studied the magnetic behaviour of different kinds of basalts and dolerites, numbering over a hundred, in fields of 1 to 10 Oe by directly displaying their Rayleigh loops. Some typical loops obtained are shown in Fig. 1, a-d. In all these cases a peak field of 10 Oe has been used so that a comparison would be quite in order. The type of behaviour obtained in 10 Oe field becomes apparent even in fields just over 1 Oe but the higher value of the field has been chosen to

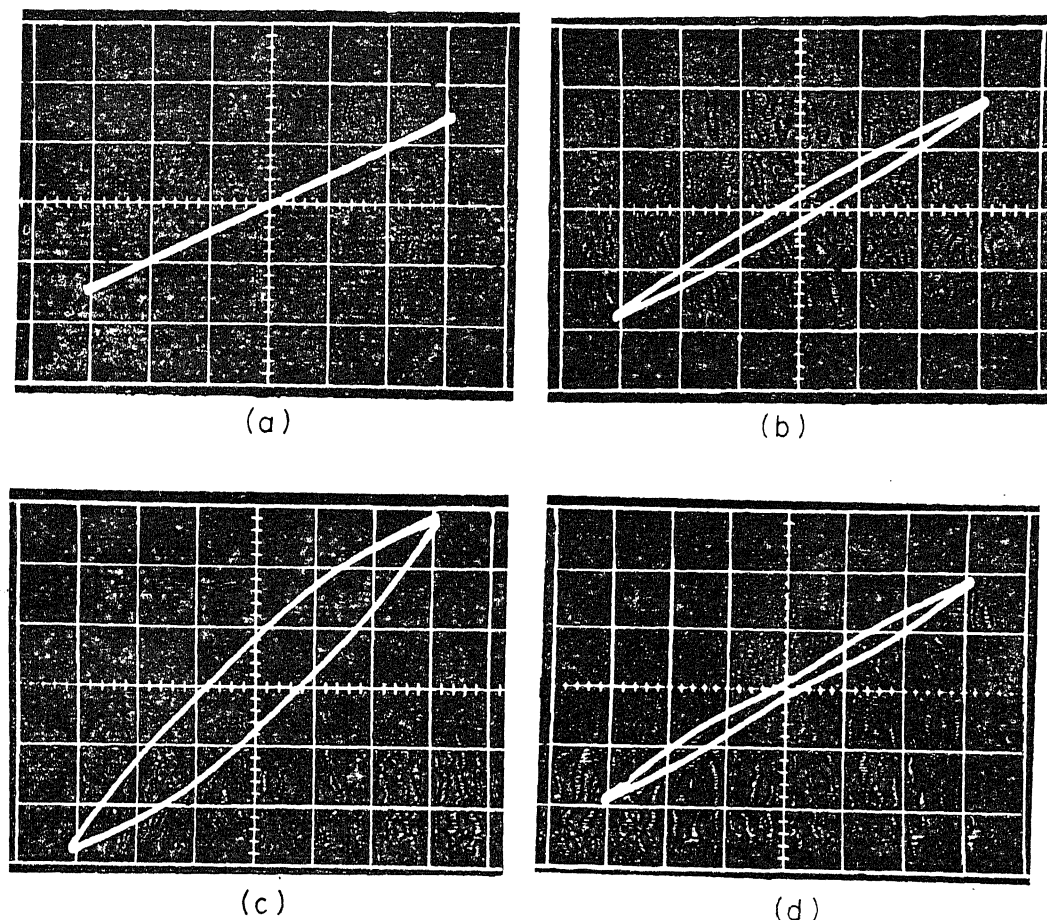


FIG. 1 (a-d). Types of Rayleigh loops of basalts.

Scale : H-axis, 1 small div. = 0.6 Oe.

M-axis, 1 small div. = 25×10^{-3} emu.

bring out the salient features more clearly. The characteristic behaviour of a particular specimen is also clearly exhibited by other specimens from the same horizon (lava flow or a dyke, etc.). Also these different types of loops are not due to anisotropy of the specimens as the loops remain the same for different orientations of the specimen with respect to the direction of the applied field.

It is quite clear from the foregoing that the behaviour of rocks varies very markedly even in such low fields, the most striking feature being the constricted loops obtained for some of the rocks. The probable explanation for constricted loops is the presence of more than one component having widely different magnetic properties as has been pointed out by Radhakrishnamurthy and Sahasrabudhe⁵ earlier.

DISCUSSION

The low field hysteresis loops generally follow Lord Rayleigh's second empirical relation namely,

$$M_H = (A + BH_m) H \pm B/2 (H_m^2 - H^2)$$

where, H_m is the maximum field applied such that $-H_m < H < H_m$, and A and B are constants characteristic of the material concerned. A is known as the reversible susceptibility whereas B can be regarded as the coefficient of irreversible susceptibility. The above equation represents a curve which has the form of nearly an elliptic loop symmetrical about the major and minor axes. However, later on Ellwood's⁶ more accurate measurements showed slight asymmetry in the loops, though his results

were in general good agreement with Rayleigh's laws.

By a graphical analysis of the Rayleigh loops of rocks it is easily possible to deduce the values of A and B constants, provided the loops are simple and nearly obey the second law. From the different types of loops presented in Fig. 1, it can be seen that the value of the constant B for different rocks varies from almost zero when the loop is a straight line (Fig. 1, a) to about 10% of that of A when the loop is quite thick (Fig. 1, c). With the present apparatus we can detect the presence of constant B if it has a numerical value of 0.5% of that of A for then the scope trace just expands into a thin loop.

In general the preliminary investigations have shown that variation of susceptibility of rocks with the applied field is quite small, if any, in fields of less than 1 Oe and that beyond this it is more pronounced as determined by an A.C. method involving rectification of the signal and reading it as current. A field of less than 1 Oe or preferably 0.5 Oe can thus be taken as a safe range for the measurement of initial susceptibility of basalts and dolerites. Thus, while using fields of more than 1 Oe in A.C. methods, it is necessary to ascertain whether the field used lies within the range of initial susceptibility of the rock concerned.

Determination of susceptibility by A.C. techniques involving null method or employing tuning in the pick-up circuit has to be avoided since the former will not be able to take care of the out-of-phase components, whilst the latter will cut them out when the constant B has an appreciable value for the specimens. On the other hand, methods involving rectification of the signal will give approximately the average value of susceptibility over the range of the field used. In any case it will be good to see the low field hysteresis loop of each rock specimen which will bring out all characteristics clearly.

Studies regarding the correlation between the constants A and B, and other magnetic and mineralogical properties of rocks, are in progress and will be reported elsewhere.

ACKNOWLEDGEMENT

We thank Dr. P. W. Sahasrabudhe for his valuable suggestions and discussions.

1. Nagata, T., *Rock Magnetism*, Maruen, Tokyo, 1961.
2. Rayleigh, Lord, *Phil. Mag.*, 1887, **23**, 225.
3. Neel, Louis, *Adv. Phys.*, 1955, **4**, 233.
4. Likhite, S. D. and Radhakrishnamurty, C., *Bull. N.G.R.I.*, 1965, **3**, 1.
5. Radhakrishnamurty, C. and Sahasrabudhe, P. W., *Curr. Sci.*, 1965, **34**, 338.
6. Ellwood, W. B., *Physics*, 1935, **6**, 215.

BRACHIOPODA * (BOOK REVIEW)

THE *Treatise on Invertebrate Paleontology* prepared under the sponsorship of the Geological Society of America is well known to all paleontologists. The aim of this undertaking is to present as complete an inventory of our present knowledge of invertebrate paleontology as possible so that it will remain an indispensable reference text for all research workers in this field, namely, study of invertebrate organisms preserved in rocks of the earth's crust. The first volume of the *Treatise* was published in 1952, and during the twelve years since then a dozen volumes have been issued, each one devoted to a particular group of invertebrates. The general treatment includes description of

morphological features, ontogeny, classification, geological distribution, evolutionary trends and phylogeny, and systematic description of genera, subgenera and higher taxonomic units.

The present publication is Part H of the *Treatise* and is devoted to Brachiopoda. Because this work contains a large number of illustrations (about 750 plates of over 5,000 figures), it is bound in two volumes but the pages are numbered continuously and the two volumes are sold as one unit.

"Brachiopoda are solitary marine animals commonly anchored to the substratum by a fleshy stalk or pedicle. The soft parts are protected by a pair of valves of variable organic and mineral composition, that cover the ventral and dorsal surfaces and project forward to enclose a cavity in which is suspended a filamentar feeding organ or lophophore". The term "Brachiopodes" was first used by Cuvier in

* *Treatise on Invertebrate Paleontology: Part H. Brachiopoda*. Editor: Raymond C. Moore. Bound in two volumes. (Publishers: University of Kansas Press and Geological Society of America, 231, East 46 Street, New York, N.Y. 17). Pp. 1-522 and 523-927. Price \$19.50.

1805 for the "acephalous molluscs" *Lingula*, *Orbicula*, and *Terebratula*, and in 1806 Dumeril proposed Brachiopoda as an order of Mollusca. Since then it has been customary to recognize the group either as a class of the Molluscoidea or Tentaculata, having equal status with the Ectoprocta and Phoronida, or latterly as a distinct phylum. From a paleontological point of view the promotion of the Brachiopoda to a phylum is taxonomically more realistic because the group, which includes some of the oldest fossils, has always been decisively different from other invertebrates.

This group of animals had a rich and long history and is now in decline. About 70 genera are found in the seas today. The occurrence of living brachiopods in almost every known environment from brackish-water tidal flats to abyssal regions over 5,000 m. deep is undoubtedly a relic of past adaptability. Fossil species of their dominant and diverse ancestors are available in every continent.

Brachiopod fossils attracted attention even in the Middle Ages, and from the late 16th century onward they were regularly figured by naturalists under a variety of names. Despite the familiarity with brachiopod shells the practice of indiscriminately grouping all the bivalves together prevailed until the close of the 18th century. During the 19th century many aspects of brachiopod organization and history were rewardingly explored. Till now about 1,700 brachiopod genera have been described, and the tempo of current research is such that this number is likely to increase substantially during the next decade or so.

Still it must be said that this revival of interest in the study of brachiopods is only of recent origin. As mentioned earlier, living

brachiopods are comparatively rare and insignificant members of the faunas of the present day, and their study was therefore neglected by zoologists early in the present century. As yet little is known about their nervous and circulatory systems, especially of articulates, while many basic histological and physiological problems, as for example shell growth, are yet to be resolved. Information on the relationship between the living brachiopod and its environment is still scanty. Much more reliable data are required even on such elementary aspects of brachiopod life as feeding habits, respiration, and population distributions and structures before most of the fossil evidence can be interpreted with any confidence.

In this context the publication of Part H on *Brachiopoda of the Treatise on Invertebrate Paleontology* will be warmly welcomed by paleontologists as a most significant addition to the literature on the subject. They owe a debt of gratitude to the Editor, and to Prof. Alwyn Williams and Prof. A. J. Rowell, the chief contributors, and their colleagues whose efforts have made it possible to bring out the twin volumes.

The first 250 pages give a general account of brachiopods under the following heads: Introduction; Brachiopod Anatomy; Morphology; Composition of Brachiopod Shell; Evolution and Phylogeny; Ecology and Paleocology; Classification; Stratigraphic Distribution; Techniques for Preparation of Fossil and Living Brachiopods. The remaining pages of Volume 1 and the whole of Volume 2 are devoted to Systematic Descriptions. These include diagnosis of nearly 1,700 genera assembled in 202 families, 48 superfamilies, 11 orders, and 2 classes.

THE INDIAN ACADEMY OF SCIENCES: THIRTY-SECOND ANNUAL MEETING

THE Thirty-second Annual Meeting of the Indian Academy of Sciences will be held at Madurai, South India, under the auspices of the Madurai University, on the 20th, 21st and 22nd December 1966.

Sir C. V. Raman, President of the Academy, will deliver the Presidential Address on "The Eye and Vision".

In the Scientific Meeting in Section A, under the Chairmanship of Dr. K. R. Ramanathan, there will be a symposium on "Active Solar Regions". The participants will include Dr. Vikram A. Sarabhai, Dr. M. K. Vainu

Bappu, Dr. R. R. Daniel and Dr. A. P. Mitra.

In a meeting of the Section B, Chairman Dr. N. K. Panikkar will give an address on "New Perspective in Brackish-water Biology". A symposium in this section on "Molecular Biology" will be led by Prof. G. N. Ramachandran on "Conformation of Proteins and Polypeptides". Prof. T. S. Sadasivan, Chairman of the second session in Section B, will give an address on "Physiology of Plants under Stress".

Public lectures will be given by Dr. S. Bhagavantam on "The Atomic Nucleus", and by Dr. Jacob Chanday on "The Human Brain".

LETTERS TO THE EDITOR

A SPHERICALLY SYMMETRIC SOLUTION OF COSMOLOGICAL INTEREST

THE results reported here have arisen out of a cosmological investigation pertaining to spherically symmetric implosions and explosions. We consider the spherically symmetric line element,

$$ds^2 = -e^\lambda dr^2 - r^2 d\theta^2 - r^2 \sin^2 \theta d\phi^2 + e^\nu dt^2 \quad (1)$$

where

$$\lambda = \lambda(r, t) \text{ and } \nu = \nu(r, t).$$

Following the usual notation we take

$$T_{\alpha\beta} = \rho v_\alpha v_\beta. \quad (2)$$

The equations determining λ and ν follow from

$$T_2^2 = 0 = T_3^3 \quad (3)$$

and

$$T_1^4 T_4^1 = T_1^1 T_4^4. \quad (4)$$

They are

$$\begin{aligned} e^\lambda \left[2 \frac{\partial^2 \lambda}{\partial t^2} + \left(\frac{\partial \lambda}{\partial t} \right)^2 - \frac{\partial \lambda}{\partial t} \cdot \frac{\partial \nu}{\partial t} \right] \\ = e^\nu \left[2 \frac{\partial^2 \nu}{\partial r^2} + \left(\frac{\partial \nu}{\partial r} \right)^2 - \frac{\partial \lambda}{\partial r} \cdot \frac{\partial \nu}{\partial r} \right. \\ \left. + \frac{2}{r} \left(\frac{\partial \nu}{\partial r} - \frac{\partial \lambda}{\partial r} \right) \right] \end{aligned} \quad (5)$$

and

$$\begin{aligned} \frac{e^\nu}{e^\lambda} (e^\lambda - 1)^2 + \frac{e^\nu}{r^3} \left(\frac{\partial \lambda}{\partial r} - \frac{\partial \nu}{\partial r} \right) (e^\lambda - 1) \\ + \frac{e^\nu}{r^2} \left(\frac{\partial \lambda}{\partial t} \right)^2 - \frac{e^\nu}{r^2} \frac{\partial \lambda}{\partial r} \cdot \frac{\partial \nu}{\partial r} = 0. \end{aligned} \quad (6)$$

Taking

$$\lambda = \sum_{n=1}^{\infty} P_{2n} r^{2n}$$

and

$$\nu = \sum_{n=1}^{\infty} Q_{2n} r^{2n}$$

where P's and Q's are functions of time, one finds

$$\begin{aligned} P_2 = 2Q_2, \quad \dot{Q}_2 = 8Q_4 - 2P_4 - Q_2^2, \\ 2\dot{Q}_2^2 + 6Q_2^3 + 3Q_2(P_4 - 4Q_4) = 0, \\ \dot{P}_4 + \dot{Q}_2^2 + 4Q_2\dot{Q}_2 = 16Q_2Q_4 - 8Q_2P_4 \\ - 2Q_2^3, \dots \end{aligned} \quad (7)$$

where an overhead dot denotes a differentiation with regard to t . The first three of these give

$$\frac{1}{2} P_2 = Q_2 = u^{-3},$$

where

$$\frac{2}{c\sqrt{c}} \left[\frac{1}{2} \sqrt{cu(cu-2)} + \log(\sqrt{cu} + \sqrt{cu-2}) \right] = t + a, \quad (8)$$

c and a being the constants of integration.

It is, however, very difficult to proceed further from (8). The equations (7) and (8) suggest the following:

$$\lambda = \sum_{n=1}^{\infty} P_{2n} \left(\frac{r}{t} \right)^{2n} \text{ and } \nu = \sum_{n=1}^{\infty} Q_{2n} \left(\frac{r}{t} \right)^{2n}$$

where P's and Q's are now constants.

The equations determining them are

$$\begin{aligned} P_2 = 2Q_2, \quad 3(4Q_4 - P_4) = 6Q_2^2 + 8Q_2, \\ 2(4Q_4 - P_4) = 6Q_2 + Q_2^2, \\ 3(6Q_6 - P_6) - 2Q_2P_4 + 10P_4 + 8Q_2^2, \\ 6Q_2(P_6 - 6Q_6) + (P_4 + 2Q_2^2)^2 \\ + 6Q_2^2(P_4 + 2Q_2^2) + 32Q_2(P_4 + Q_2^2) \\ + 4(P_4 - Q_4)(P_4 + 4Q_2^2) + 4Q_2^2(P_4 - 4Q_4) \\ + 8Q_2^4 - 16P_4Q_4 = 0. \end{aligned} \quad (9)$$

Solving equations (9) one gets

$$\begin{aligned} P_2 = \frac{4}{9}, \quad P_4 = \frac{32}{81}, \dots; \\ Q_2 = \frac{2}{9}, \quad Q_4 = \frac{22}{81}, \dots; \end{aligned} \quad (10)$$

leading to

$$e^\lambda = 1 + \frac{4}{9} \cdot \frac{r^2}{t^2} + \frac{40}{81} \cdot \frac{r^4}{t^4} + \dots$$

and

$$e^\nu = 1 + \frac{2}{9} \cdot \frac{r^2}{t^2} + \frac{8}{27} \cdot \frac{r^4}{t^4} + \dots \quad (11)$$

Since, in the usual notation,

$$8\pi\rho = e^{-\lambda} \left[\frac{\lambda}{r} - \frac{\nu'}{r^2} \right] + \frac{2}{r^2},$$

one finds

$$8\pi\rho = \frac{4}{3} \cdot \frac{1}{t^2} + \frac{8}{9} \cdot \frac{r^2}{t^4} + \dots; \quad (12)$$

From this we have using (2) and

$$\begin{aligned} g_{\alpha\beta} v^\alpha v^\beta = 1, \\ v^1 = \frac{2}{3} \cdot \frac{r}{t} + \frac{2}{343} \cdot \frac{r^3}{t^3} + \dots; \end{aligned} \quad (13)$$

and

$$v^4 = 1 + \frac{71}{81} \cdot \frac{r^2}{t^2} + \dots \quad (14)$$

To make the calculations simpler Q_0 was taken as zero while defining ν . A constant Q_0 provides the parameter required on the right-

hand side of (12) for making the necessary adjustment of the field with reference to physical conditions. Q_0 would naturally affect the coefficients in (11) as well.

What is significant is that near the origin, the density $\rho \propto r^{-2}$ and that r^4 is suggestive of the velocity-distance law.

My thanks are due to Professor V. V. Narlikar, Lokamanya Tilak Professor of Applied Mathematics, University of Poona, for suggesting the problem and for valuable guidance throughout the preparation of this note.

Department of Mathematics K. B. MARATHE,
and Statistics,
University of Poona,
Poona-7, September 2, 1966.

1. Tolman, R. C., *Relativity, Thermodynamics and Cosmology*, 1934.
2. Narlikar, V. V., *Philosophical Magazine*, Ser. 7, Nov. 1936, 22, 767.

N.M.R. STUDY OF HEXAMETHYLENETETRAMINE AT ROOM TEMPERATURE

The present study of proton magnetic resonance of hexamethylenetetramine ($C_6H_{12}N_4$) at room temperature reveals the check of molecular structure and also the discrepancy of second moments calculated by various workers.⁹⁻¹⁰ The authors have also calculated the second moments taking different C-H distances.

The structure of hexamethylenetetramine has been investigated by X-ray method by R. G. Dickson and A. L. Raymond.¹ They found that it is a body-centered cubic lattice with $a = 7.02 \text{ \AA}$ and $Z = 2$, lying in the space group T^h ($I\bar{4}3m$). This structure is in one of the unique cases where the molecules of point groups $\bar{4}3m$ completely retain their symmetries in the crystal. Within the experimental error the valence angles are tetrahedral ($110^\circ 6'$) with $C-N = 1.44_s \pm 0.01_s$ and $C-H = 1.09$.

Different workers have referred different values of C-H distance; thus Schomaker and Shaffer² have taken $C-H = 1.09$, Anderson³ has taken it as (1.13) and R. Brill and co-workers⁴ as (1.175) according to their different techniques of measurement.

The present work deals with the measurement of second moment (Van Vleck)⁵ at room temperature (16°C .) and was corrected for modulation amplitude (Andrew).⁶ The second moment (S_0) is calculated from the sum of intramolecular (S_1) and intermolecular (S_2) contributions. Moreover the intermolecular contribution can be broken into truncated con-

tributions at radius M (where $r_{jk} \gg M$) and terminal contributions (Ibers and Stevenson).⁷ It is often found necessary to treat only neighbours up to about 5 \AA distant and to change the sum for remaining ones into an integral assuming the more distant neighbours to be uniformly distributed with known density (Andrew).⁶ In the present case the second moment at room temperature is approximately the same as at rigid lattice temperature. Hence the value of (S_1) is calculated in Table I taking the different values of C-H at room temperature using the formula for protons:

$$S_1 = 358.1 N_0^{-1} \sum n_i \sum r_{ij}^{-6} \text{ gauss}^2.$$

The intermolecular contributions can be calculated by the formula:

$$S_2 = 358.1 N_0^{-1} \sum n_j^2 \sum_i N_i \sum r_{jk}^{-6} \\ + 358.1 \times 4\pi N_p (3M^3 V)^{-1}$$

where r_{jk} is the radius between protons j and k , N_0 is the per molecule proton number, n_i is the equivalent protons of type i , M is the cut-off radius, V is the volume of unit cell in \AA^3 and N_i is the number of molecules on the i -th nearest neighbour sites.

TABLE I
Intramolecular contribution at room temperature

C-H in \AA	Intramolecular contribution (S_1)
1.17	12.30 (gauss ²)
1.13	14.23 "
1.09	16.61 "

Yagi⁹ has worked on the same problem and calculated the second moment at room temperature assuming $C-H = 1.09 \text{ \AA}$ and tetrahedral angle. He found second moment to be $16.8 \pm 0.5 \text{ gauss}^2$ which is in disagreement with theoretical value. Later G. W. Smith¹⁰ also calculated and found second moment 20.2 gauss^2 taking $C-H = 1.13 \pm 0.02 \text{ \AA}$. He emphasised that the discrepancy in result arises from the fact that Yagi has neglected the intermolecular contribution assuming that it is less than 0.1 gauss^2 . Thus the second moment is practically all-intramolecular contribution. According to Smith (S_2) must be taken into account. He calculated (S_2) of hexamethylenetetramine and found to be 5.80 gauss^2 for $M = 4.80 \text{ \AA}$. Here authors have calculated the theoretical value of second moment taking $C-H = 1.09$ and also the contribution of nitrogen nuclei as follows:

$$S_0 = S_1 + S_{2\text{trunc}} + S_{2\text{term}} + \text{nitrogen contribution} \\ = 16.61 + 4.86 + 0.94 + .05 \\ = 22.46 \text{ gauss}^2.$$

A SYNTHESIS OF α -TERTHIENYL-
METHANOL, A COMPONENT OF
ECLIPTA ALBA

RECENTLY we reported¹ the isolation of a new polythienyl alcohol from the leaves of *Eclipta alba* and its characterisation as α -terthienyl-methanol. Its structure has now been confirmed by synthesis.

A mixture of α -terthienyl (100 mg.) prepared according to the method of Sease and Zechmeister,² dimethylformamide (40 mg.) and phosphorus oxychloride (60 mg.) was heated at 100° for 10 min.; cooled, and after 2 hr. heated with aqueous sodium acetate (120 mg. in 2 ml.) on a boiling water-bath for $\frac{1}{2}$ hr. The product (100 mg.) was a mixture (TLC) of two compounds both of which were different from the starting material. It was dissolved in benzene and chromatographed over silica gel and developed with benzene. The first 60 ml. of the eluate yielded 2-formyl- α -terthienyl (40 mg.) which separated from benzene as yellow glistening needles, m.p. 130–132°, $\lambda_{\text{max}}^{\text{MeOH}}$ (Qual.) 239, 266 and 394 m μ . (Found: C, 56.5; H, 3.2. $\text{C}_{13}\text{H}_8\text{O}_3$ requires C, 56.5; H, 2.9%.) Takano *et al.*³ who prepared this aldehyde by the same reaction reported a m.p. 134°. Subsequent benzene eluate, exhibiting marked green fluorescence, yielded an orange compound (10 mg.) which crystallised from benzene as needles, m.p. 215–218°, $\lambda_{\text{max}}^{\text{MeOH}}$ (Qual.) 250, 276 and 406 m μ . (Found: C, 55.4; H, 2.7. $\text{C}_{14}\text{H}_8\text{O}_3\text{S}_2$, 2,5"-diformyl- α -terthienyl, requires C, 55.3; H, 2.6%.) A solution of 2-formyl- α -terthienyl (10 mg.) in ethanol (40 ml.) was treated with aqueous NaBH_4 (10 mg. in 1 ml.) and the mixture allowed to stand for 8 hr. The solvent was distilled off under reduced pressure and the residue extracted with ether. The ether solution yielded α -terthienylmethanol which crystallised from benzene as lemon yellow plates, m.p. 150–151° (uncorrected), identical with that of the natural sample. Its UV and IR spectra were indistinguishable from those of the natural sample.

We thank Dr. B. D. Tilak for a generous gift of thiophene.

Dept. of Chemistry, N. R. KRISHNASWAMY.
University of Delhi, T. R. SESHADRI.
Delhi-7, August 10, 1966. B. R. SHARMA.

THE INFLUENCE OF THE SUBMANDI-
BULAR SALIVARY GLAND ON GROWTH
(Preliminary Communication)

THE submandibular salivary gland, one of the three major salivary glands in humans and other mammals, is only known to be a pure exocrine gland with the prime and only function of secreting saliva.¹ The structure is known to be of the mucoserous type.^{2,3} Our experiments indicate that beside its exocrine function, it has certain other actions which are endocrinoid in nature; namely the control of growth.

The preliminary studies were done on 100 Swiss albino mice (8–9 days old), 20 Swiss albino rats (11–12 days old) and a few cats, dogs and monkeys (*Macaca radiata* Linn.). The animals were selected and distributed in such a way that in all cases except the monkeys the control and the experimental group were litter-mates belonging to the same sex.

The batches of animals were divided into three groups; in the experimental group, the submandibular salivary glands were surgically removed at operation, using a small horizontal incision in the mid-ventral line of the neck, close to the symphysis menti. Anaesthetic ether puris was used as the anaesthetic in the case of the rodents, by the open drop method; and Thiopental sodium BP (parenteral) was used in the case of other animals (25–30 mg./kg. body weight). In the first control group, a similar incision was made to ligate the ducts of the glands at the hilus; without disturbing the adjoining structures. In the second control group no operation was done at all. The control animals received the identical amount of food (B. J. M. C. labs. nutritional diet 102) and water that was consumed by the experimentals.

The controls (both the non-operated and the duct-ligated animals) were completely normal and showed a normal growth pattern. However, the animals which had undergone bilateral submandibularectomy showed a marked reduction both in the rate and degree of growth; being nearly half the weight of the controls. The milestones of growth appeared at a slower rate. They were healthy but were stunted in growth and were physical dwarfs. Our results were consistent in all the cases. The difference in the sizes of the experimentals and the controls was similar to the picture of hypophysectomy. The earliest work on this was by Plagge in 1938⁴ who stressed the importance of the salivary glands to the newborn rats which died when they were removed, but ascribed his findings to the loss of salivary secretion.

1. Krishnaswamy, N. R., Seshadri, T. R. and Sharma, B. R., *Tetrahedron Letters*, 1966, No. 35, 4227.
2. Sease, J. W. and Zechmeister, L., *J. Amer. Chem. Soc.*, 1947, **69**, 270.
3. Takano, T., Iwata, T., Atarshi, S. and Okada, S., *Japan J. Pharm. Chem.*, 1965, **36**, 22.

That the retardation of growth is not due to the loss of salivary secretion is proved by the fact that ligation of the duct of the submandibular gland with a consequent blockade of the secretion of saliva and a resultant pressure atrophy of the exocrine cells, produces no change in the growth pattern, while it is the bilateral ablation of the gland, involving the loss of some 'internal secretion or factor' which causes this retardation of growth resulting in dwarfism. Since litter-mates were chosen the genetical factor was controlled to the maximum. That this phenomenon is not due to any nutritional or dietetic variance is proved by the fact that the controls were given the identical amount of the same food as was consumed by the experimentals; nor is it due to the trauma of the operation, with resultant traumatic dysphagia, because the operation for the ligation of the ducts involves the same amount of tissue injury, yet the growth of the duct-ligated controls was normal. This necessarily indicates the presence of some internal endocrine-like factor secreted by the submandibular salivary gland which influences growth. While further work is in progress to isolate the active principle involved, this paper has been put forth as a preliminary communication.

We are grateful to Dr. F. J. Mendonca, Dean, B. Medical College and Sassoon Hospitals, for his kind encouragement during the course of the work.

B.J. Medical College and M. J. NARASIMHAN (JR.).
Sassoon General V. G. GANLA.
Hospitals, Poona, May 3, 1966.

1. Burgen, A. S. V. and Emmelin, N. G., *Physiology of the Salivary Glands*, Edward Arnold (Publishers) Ltd., London, 1961.
2. Szymanska, Z., *Acta Theriologica*, 1963, 7(3), 25.
3. — and Zofia, *Folia Morphol.*, 1962, 13(2), 195.
4. Plagge J. C., *Am. J. Physiol.*, 1938, 124(3), 612.

EFFECT OF A FOREIGN BODY ON OXYGEN CONSUMPTION OF THE RAT UTERUS

It has been reported previously that an intrauterine foreign body (IUFb) causes a progressive increase in oxygen consumption of the rat uterus.¹ A similar rise in oxygen uptake of the rhesus monkeys uterus has been noted after the insertion of a plastic contraceptive coil (Margulies spiral); at 90 days post-insertion the increase is about 21%, but after 545 days the oxygen consumption of the organ is normalized.^{2,3} Evidently, the pattern of change in oxygen uptake of the uterus pro-

voked by a foreign body is different in the two species. Accordingly, it has been considered worthwhile to examine the oxygen consumption of the rat uterus after prolonged residence of an IUFb.

Colony-bred adult albino rats (150–170 gm.) of the Institute were used in this investigation. A surgical silk suture was inserted through the antimesometrial wall of the right uterine horn under ether anaesthesia according to the procedure described previously.¹ The two ends of the suture were tied in a knot with sufficient margin to permit free movement of the uterus. The needle was passed in an identical manner through the contralateral horn without leaving a suture in place. All operations were done under aseptic precautions. The animals were maintained in airconditioned quarters (temperature: $75 \pm 2^\circ \text{F.}$) under uniform husbandry conditions throughout the experimental period.

The rats were sacrificed 25, 200 and 400 days after insertion of the suture. In order to eliminate variations due to the estrus cycle this investigation was carried out only at estrus. The oxygen uptake (QO_2) was measured in thin slices (80–100 μ) of uterine tissue by the procedure of Umbreit *et al.*⁴

It will be evident from the results presented in Table I that 25 days after insertion of the

TABLE I
The oxygen consumption of the rat uterus in
the presence of a foreign body

Days after introduction of the intrauterine foreign body	Oxygen consumption (QO_2)		Increase %
	Control horn	Treated horn	
25*	12.80 (3)† (10.10–14.03)	15.70 (3) (13.33–16.16)‡	22.7
200*	10.60 (3) (8.30–12.80)	21.30 (3) (19.70–23.90)	100.9
400	11.30 (15) (11.00–11.30)	17.90 (15) (16.90–18.90)	58.4

* Data from Kar *et al.*¹ † No. of uterine horns.
‡ Mean with range in parenthesis.

foreign body the oxygen consumption of the treated horn was 22.7% higher than that of the control horn. This value was as high as 100.9% at 200 days post-insertion, but at 400 days it was relatively less being 58.4% higher than that of the control horn.

The results of the present study show that an IUFb causes a progressive increase in oxygen consumption of the rat uterus for a period of time followed by a relative decline. On the basis of detailed biochemical investigation it has been suggested that such increase in oxygen uptake denotes a trauma to the uterine tissue.³

In rhesus monkeys such trauma appears to be mild and transitory perhaps due to the 'free' luminal residence of the plastic coil; there is only a marginal increase in oxygen consumption which is normalized eventually, suggesting an adaptation of the uterus to the foreign body after the initial traumatic reaction.³ In rats, on the other hand, due to a different disposition of the foreign body (a permanent silk suture stitch on the uterine wall) such trauma appears to be more severe and persistent, the adaptation to the foreign body evidently taking a much longer time. A relative decrease in oxygen consumption of the uterus after as long as 400 days post-insertion is consistent with this possibility.

This investigation was supported by a grant from the Ford Foundation. Thanks are due to Dr. M. L. Dhar for his interest in this study.

Central Drug Res. Inst., AMIYA B. KAR.
Lucknow, V. P. KAMBOJ.
August 26, 1966. A. R. CHOWDHURY.

1. Kar, A. B., Kamboj, V. P., Goswami, A. and Chowdhury, S. R., *J. Rep. Fertl.*, 1965, **9**, 317.
2. —, Chowdhury, S. R., Kamboj, V. P., Chandra, H. and Chowdhury, A. R., *Int. J. Fertl.*, 1965, **10**, 321.
3. —, Kamboj, V. P., Chowdhury, S. R., Chandra, H. and Chowdhury, A. R., *Amer. J. Obst. Gynecol.*, 1966, (in press).
4. Umbereit, W. W., Burris, R. H. and Stauffer, J. F., *Manometric Techniques*, Burgess Publ. Co., Minneapolis, 1957.

THE ACTIVITY CYCLE OF THE LESSER BANDICOOT RAT, *BANDICOTA BENGALENSIS*

The lesser bandicoot rat, *Bandicota bengalensis*, occurs throughout most of India. It lives both in fields and in buildings and is the dominant rodent in Bombay¹ and in Calcutta² where it is found in large numbers in food godowns. Any effective control measures against rodents must be based upon the ecology and behaviour of the animals. This study is of one aspect of the behaviour of *B. bengalensis*, the daily cycle of activity.

Two females and one male, all adults, were used in this study. All were captured in Singur, District Hooghly, West Bengal, where the bandicoot population is much lower than in Calcutta thirty miles away. Each animal was caged separately in a small cage attached to an activity wheel in which the animal could run at will. The small cages were furnished with conventional water bottles, food dishes, and with segments of bamboo in which the animals slept. The activity wheels and their attached

cages were housed in larger cages covered by a roof. The studies were conducted in sheltered places on the roof of the laboratory.

A counter attached to each of the activity wheels indicated the number of revolutions made by the wheel. Hourly readings were made during the day and night. The two females were observed for 30 days each and the male for 37, for a total of 97 bandicoot-days.

The results are summarized in Fig. 1 in which

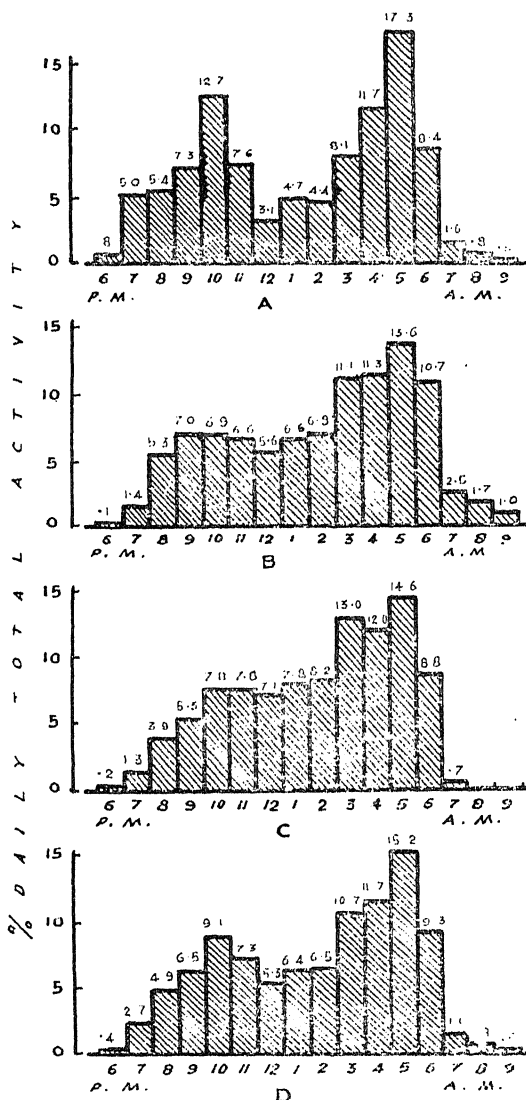


FIG. 1. Activity cycles of three lesser Bandicoot Rats (*Bandicota bengalensis*) A-30 days, B-3 days, C-30 days, D-Summary of A, B and C.

the average per cent of the total daily activity is shown for the hours 6 p.m. to 9 a.m. Because there was only an insignificant amount

of activity between 9 a.m. and 6 p.m., those hours have been omitted from the figure.

Like many other nocturnal animals,^{3,4} *B. bengalensis* shows strong peak of activity shortly before dawn and a tendency toward a weaker, less regular peak in the early hours of the night (Fig. 1).

Although these three individuals probably reflect the activity patterns of bandicoots in medium or low populations, until further studies are made, caution should be used in generalizing about the daily cycle of activity of bandicoots in high population (as in godowns in large cities), since population density is known to have far-reaching effects on the behaviour of animals.^{5,6}

The Johns Hopkins University,
Center for Medical Research
and Training,
c/o. All-India Institute of
Hygiene and Public Health,
110, Chittaranjan Avenue,
Calcutta (India), June 22, 1966.

1. Deoras, P. J. and Gokhale, M. S., *J. Bombay Nat. Hist. Soc.*, 1958, **53**, 450.
2. Spillett, J. J., personal communication, 1966.
3. Pearson, O., *J. Mammal*, 1959, **40**, 169.
4. Brown, L. E., *Proc. Zool. Soc. London*, 1956, **126**, 549.
5. Christian, J. J. and Davis, D. E., *Sci.*, 1956, **146**, 1550.
6. Leyhausen, P., *Discovery*, September 1965, p. 7.

TARAXEROL FROM RUBBER LEAVES

The tree *Hevea brasiliensis* (H. B. K.) Muell-Arg (Euphorbiaceae) is well known for its latex used in the manufacture of rubber. The press cake or extracted meal of rubber seeds is used as a fertilizer or as a medium protein concentrate feed for livestock. Excepting for the reported presence of the cyanogenetic glycoside, linamarin, in the seeds and the composition of the seed oil,¹ it seems that no other chemical studies have been reported so far in the literature. In view of the reported toxicity of rubber leaves to cattle in Kerala State, detailed chemical examination of the leaves was undertaken.

The leaves were obtained through the courtesy of the Principal, Kerala Veterinary College, Trichur. Air-dried and powdered leaves were repeatedly extracted with boiling alcohol and the combined filtrates were distilled under reduced pressure to remove the solvent. The residue was digested with petroleum ether

(40-60°) and the extract was decolourised with animal charcoal. The filtrate was concentrated to a small volume and allowed to cool in the refrigerator when a white precipitate was deposited at the bottom of the flask. The compound was separated and repeatedly crystallized from benzene and a mixture of chloroform and methanol when colourless needles were obtained melting at 268°. Liebermann-Burchard test was positive and it gave the typical sequence of colours from yellow to purple on treatment with thionyl-chloride in the presence of tin indicating the compound to be triterpene. Acetylation with acetic anhydride and pyridine yielded an acetate which on crystallization from chloroform and methanol melted at 292-293°. On oxidation with chromic acid, it gave a ketone melting at 240-241°. From the physical constants and the various derivatives, the compound has been identified as taraxerol and confirmed by the mixed melting point with an authentic sample.

Thanks are due to Dr. V. Mahadevan, Head of the Animal Nutrition Division, for his kind interest and encouragement.

Division of Animal Nutrition, M. S. SASTRY.
I.V.R.I., Izatnagar, June 13, 1966.

1. *The Wealth of India, Raw Materials*, Council of Scientific and Industrial Research, New Delhi, 1959, **5**, 74.

OCCURRENCE OF *CLIBANARIUS ZEBRA* DANA (CRUSTACEA-DECAPODA) FROM THE INDIAN COAST

THIS short note is based on three specimens of Pagurids received for determination from the Western Regional Station, Zoological Survey of India, Poona. The material was collected during 1963 at Devged on the Arabian seacoast by Dr. B. K. Tikader. All the specimens were males and found inhabiting the molluscan shells of *Trochus radiatus* Gmelin. Length of carapace of the large specimen measured 10 mm.

The specimens possess subequal Chelipeds the right slightly larger and provided with white granule like tubercles. Walking legs have red longitudinal stripes. Dactylus is shorter than propodus, white in colour, with upper and lower red streaks. Except for a few minor characters, which are enumerated below, the specimens agree entirely with the description of *Clibanarius zebra* Dana 1852.

Clibanarius zebra DANA

Specimens from Devgad

1. Eye Stalks

- (a) With a longitudinal red stripe above.
(b) Not as long as the anterior margin of carapace.

2. 2nd & 3rd Pairs of Thoracic Legs

With longitudinal red stripes. One dark stripe on outer surface, one below, one above and one on the inner side (altogether 4).

No stripe, but with uniform red colour.

Distinctly longer than the anterior margin of carapace, and as long as the antennular peduncles.

With red stripes all along the length of Merus, Carpus and Propodus. One dark stripe on outer surface towards the lower border, one above and one on the inner side (altogether 3).

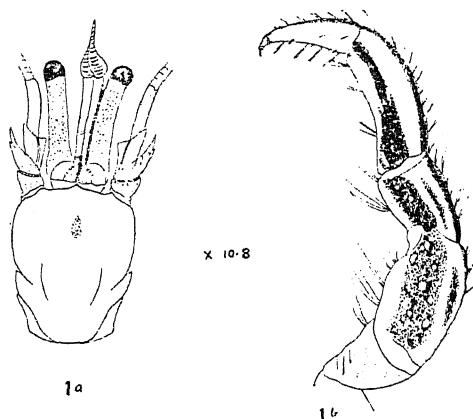


FIG. 1 a-b *Clibanarius zebra* Dana. Fig. 1 a, Anterior part of the body in dorsal view, $\times 10.8$. Fig. 1 b, Left third thoracic leg. $\times 10.8$.

Dana (1852) described *Clibanarius zebra* on material obtained from Sandwich Islands (S. Atlantic). Borradaile (1898) recorded it from Funafuti (Ellice Is.—Pacific Ocean) and Nobili (1907) from Polynesia. Buitendijk (1937) subsequently reported this species from the Indonesian Islands based on material collected by Snellius Expedition. Edmondson (1933 and 1946) and Mackay (1945) further recorded this species from Hawaii Islands. So far, this species is not recorded from Indian waters. Therefore, its occurrence from west coast of India for the first time, is of considerable interest.

I am thankful to Sri. G. Ramakrishna, Zoological Survey of India, for guidance and helpful suggestions in the preparation of this note.

Zoological Survey of India,
Calcutta, April 20, 1966.

K. N. REDDY.

1. Borradaile, L. A. *Proc. Zool. Soc.*, London, 1898, p. 463.
2. Buitendijk, A. M., *Temminckia*, 1937, 2, 251.
3. Dana, J. D., *U.S. Expl. Exp. Crust.*, 1852, Pt. 1, p. 465.

4. Edmondson, C. H., *Special Publ. B.P. Bishop Mus.*, 1933, 22, 226.
5. —, *Ibid.*, 1946, 22, 265.
6. MacKay, D. C. G., *Nautilus*, 1945, 58, 120.
7. Nobili, G., *Mem. R. Accad. Sci.*, Turin, 1907, Ser. 2, 57, 367.

OCCURRENCE OF A HIGH MONOCROTALINE YIELDING STRAIN OF *CROTALARIA RETUSA*

MORE than 75 pyrrolizidine bases are known to occur¹ in plants belonging to the genera *Senecio*, *Erechtites*, *Nardosmia* (*Compositae*), *Crotalaria* (*Leguminosae*), *Heliotropium*, *Cynoglossum*, *Trichodesma* and *Trachelanthus* (*Boraginaceae*). These alkaloids have been studied extensively in South Africa,² Australia,³ Russia⁴ and India⁵⁻⁶ due to their poisonous properties. In recent years added interest in these bases has been created by reports⁷ of their interesting pharmacological mutagenic and antitumour activities.

The alkaloid monocrotaline, originally isolated by Neal, Rusoff and Ahmann from *C. sericea*⁸ was later found to occur in *C. retusa*.⁹ It has also been shown to occur in Australian *C. retusa*¹⁰ and *C. spectabilis*,¹¹ Indian *C. sericea*,¹² *C. grahamiana* and *C. retusa*. In view of the recent reports of hypotensive, mutagenic and antitumour activities of monocrotaline this alkaloid has been prepared commercially and is listed in *Catalogue of Biochemicals* (L. Light and Co.).

In order to discover a good commercial source of monocrotaline we collected several geographical strains of *C. retusa* including samples from Brazil, USDA, Coimbatore (Kerala) and Sagar (M.P.). These were grown in the nursery of R.R.L. Jammu and analysed for total alkaloids and monocrotaline. The highest yield of total alkaloids 10-12% was obtained from *C. retusa* of Brazilian origin (assayed by the method of Culvenor and Smith¹³) consisting chiefly of monocrotaline.

50 g. of *C. retusa* seed powder was defatted by continuous hot extraction with petroleum ether

60–80°. The defatted material was extracted with 95% alcohol in a soxhlet extractor and solvent removed from the extract over a water-bath. The residue was dissolved in 5% sulphuric acid, the clear acid extract was made alkaline and extracted with chloroform. The residue from chloroform extract on crystallization from methanol gave 4.47 g. of pure monocrotaline (m.p. 196–97°; m.m.p. undepressed; single spot TLC, Rf. 0.42; m.p. picrate 231° in agreement with previous reports). A second batch of 50 g. of seeds was processed in the same manner with the difference that acid solution of total bases was reduced with zinc dust, in order to convert N-oxides into tertiary bases for 12 hours before extracting the alkaloids with chloroform. From the residue of chloroform extract, 4.64 g. of pure monocrotaline was recovered by crystallization from methanol. Thus the percentage of monocrotaline occurring as tertiary base is 8.94 and that occurring as N-oxide is 0.34% giving a total of 9.28%. This is the highest yield reported so far of any pyrrolizidine base and this strain can be utilised for commercial manufacture of monocrotaline.

The mother liquor after removal of monocrotaline gives evidence of the existence of 3 additional bases (Rf. on TLC, 0.49; 0.32 and 0.08).

Regional Research Lab., SUBHASH KUMARI.
Jammu, April 12, 1966. K. K. KAPUR.
C. K. ATAL.

1. Boit, H. G., *Ergebnisse der alkaloid-Chemie* Biss., 1960, Academic Verlag, Berlin, 1961, p. 86.
2. Warren, F. L., *Fortschr. Chem. Org. Naturstoffe*, 1955, **12**, 99.
3. Culvenor, C. C. J., *Current Trends in Heterocyclic Chemistry*, Academic Press, New York, 1958, p. 103.
4. Areshkina, L. Y., *Biokhimiya*, 1957, **22**, 527.
5. Sharma, R. K., Kasture, A. V., Kapur, K. K. and Atal, C. K., *Llodia*, 1965, **28**, 909.
6. Rajagopalan, T. R. and Seshadri, T. R., *Curr. Sci.*, 1964, **33**, 163.
7. Kupchan, S. M., Doskotch, R. W. and Vanevenhoven, P. W., *J. Pharm. Sci.*, 1964, **53**, 343.
8. Neal, W. M., Rusoff, L. L. and Ahmann, C. F., *J. Am. Chem. Soc.*, 1935, **57**, 2560.
9. Adams, R. and Rogers, E. F., *Ibid.*, 1939, **61**, 2815.
10. Culvenor, C. C. J. and Smith, L. W., *Aust. J. Chem.*, 1957, **10**, 464.
11. — and —. *Ibid.*, 1957, **10**, 474.
12. Sethi, M. L., *Dissertation*, Punjab University, 1964.
13. Culvenor, C. C. J. and Smith, L. W., *Aust. J. Chem.*, 1955, **8**, 556.

HYBRID NECROSIS IN BREAD WHEAT

HERMSEN¹ (1963) who extensively studied hybrid necrosis in wheat concluded that necrosis as such is determined by the interaction of two complementary genes, designated as Ne_1 and Ne_2 and their alleles as s (strong), m (moderate) and w (weak). Tsunewaki and Nishikawa² (1964) are of the opinion that three complementary genes, Ne_1 , Ne_2 , and Ne_3 , cause in combination a progressive necrosis in common wheat and Ne_1 gene located in B, Ne_2 in A and Ne_3 in D genome of hexaploid wheat. In India no work seems to have been reported on this aspect.

With the availability of diverse reservoir of collection of dwarfing and res-genes at the I.A.R.I. and its Substations comprehensive hybridization programme has been underway at Pusa, to breed stiff strawed, disease resistant wheat varieties which can suit varied agro-climatic conditions in the eastern parts of India. Hybrids from most of the crosses involving indigenous blood were normal. However, some crosses gave rise to F_1 plants, which were "Necrotic". The first symptom of 'Necrosis' consists of dull-light green spots (mottling) on the leaves which enlarge and become more numerous until they join and form large zones turning brown by that time. These symptoms progress from leaf-tip towards base and involve leaf-sheath as well. The degree of necrosis was classified into three groups: severe necrosis, moderate necrosis and weak necrosis.

Severe Necrosis.—The first symptom may appear in any growth stage of the plant from 2–3 leaf stage onwards and die in the 3–6 leaf stage without forming any lateral shoots. There is a complete mortality in the seedling stage itself. A large number of exotics namely E 771, E 4717, E 4870, E 4871, E 4894, E 5892, E 5982, E 6031, S 211, S 225, Lerma Rojo 64 A, Nadadores 63 and Penjamo 62 when crossed with C 306—a widely adaptable improved wheat, resulted in the development of severe necrotic F_1 plants. These exotics when intercrossed amongst themselves did not express this phenomenon.

Moderate Necrosis.— F_1 manifested the first symptom in the early tillering phase and produced a complete leaf apparatus but the ear size and seed-setting was severely affected. The kernels produced were premature, shrivelled and of very low grain weight. Giza 150 from International Test Nursery when crossed with Lerma Rojo, V 17 and V 18 (all Mexican dwarfs) expressed moderate necrosis.

Weak Necrosis.—The weak degree of necrosis consisted of yellowing of leaves which did not

interfere much with the seed-setting and development of grains. This first became visible about the heading stage in the cross of Penjamo 62 with Pbc. 303.

Besides the preliminary observations of necrosis in the hybrids involving wheats of diverse collections *versus* some Indian stocks, certain genetical implications appear imminent. Operation of dominant complementary genes is indicated by the expression of necrosis in F_1 . Moreover, variation in the degree of necrosis in such hybrids is suggestive of multiple alleles differing in expressivity. The determination and location of these genes in the various indigenous and exotic collections is a useful prerequisite for the wheat breeding programme in India and is being followed up by the authors.

Indian Agricultural Research Institute,
Botanical Substation,
Pusa (Bihar), May 10, 1966.

P. N. NARULA.
SOBARAN SINGH.
P. S. L. SRIVASTAVA.

1. Hermesen, J. G. Th., *Genetica*, 1963, **33**, 245.
2. Tsunewaki, K. and Nishikawa, K., *Wheat Inform. Serv.*, 1964, **17**, 18, 40.

OBSERVATIONS ON DORMANCY IN RICE SEED

SEED dormancy has been studied in some detail in respect of several seeds, including rice, and some methods have been suggested to break dormancy.¹⁻⁶ In the course of a study on seed dormancy in certain rice varieties at this Institute, it became evident that although some of the methods reported earlier suited our purpose, others required some modification. This note embodies the observations of a comparative study, made with a view to ascertain, (i) relative efficiency of the methods tried, (ii) practicability for adoption by the farmer and (iii) utility in respect of dry nursery practice.

In the adoption of each of the methods, the seeds after treatment were washed with distilled water and transferred to petri plates (with filter-paper) in triplicate at the rate of 50 seeds per plate. *Mtu. 17*, *Ac. 511* and *Nagpur-22* were the three varieties of rice selected for this trial. Seed germination was allowed by incubation of the plates at 32° C. The percentage of seeds germinated was calculated with counts recorded after seven days of incubation. The results of germination are presented in Table I for the different methods detailed below.

TABLE I

Percentage of germination in different methods
in three dormant varieties of rice
(Average of two trials)

Method	Germination %			
	Variety			
	Mtu. 17	Ac. 511	Nag. 22	Mean
1	73	91	70	78
2	65	77	71	71
3	65	83	62	70
4	62	60	68	63
5	68	79	68	72
6	70	92	78	80
7	10	13	34	19

C.D. (0.05) for method 5.

METHODS

1. *Thiourea*.^{3,6}—Seeds soaked in water for 20 hrs. and kept for two hrs. in 0.5% thiourea solution.
2. *Mercuric chloride*.²—Presoaked seeds in water for 6 hrs. treated with $HgCl_2$ (1:1000) for 2 mins.
3. *Centrifuging*.⁵—Centrifuging for 10 minutes (1500 r.p.m.) presoaked seeds in water for 6 hrs.
4. *Sulphuric acid*.²—Presoaked seeds for 18 hrs. in water were treated with N/10 H_2SO_4 for 3 hrs.
5. *Soaking and shaking in water*.¹—Shake for $\frac{1}{2}$ hr. presoaked seeds in water for 3 hrs. and set aside overnight.
6. *Storing dry seeds*.⁴ at 42° C.—Seeds stored at 42° C. for 7 days.
7. *Control*.—Soaking in water for 24 hrs.

The results indicate that (a) seeds treatment by method (1) gave the highest germination percentage for *Mtu. 17* and by method (6) for *Ac. 511* and *Nagpur-22*. (b) In general, method (1) or (6) gave best results for all three varieties of rice and (c) even the simple technique of soaking and shaking the seed in water (method 5) improved germination considerably of otherwise dormant seeds.

From a consideration of the objects of the investigation, methods (1) and (6) are satisfactory, while simplicity for adoption by the farmer goes in favour of method (5). For dry nursery practice, method (6) is suitable.

The authors are thankful to Dr. R. H. Richharia, Director, for his keen interest in the present investigations.

Central Rice Research Institute, K. S. MURTY.
Cuttack-6 (India), P. RAGHAVALAH.
April 9, 1965.

1. Barton, L. V., *Contrib. Boyce Thompson Inst.*, 1947, 14, 355.
2. Butany, W. T. and Gangadharan, C., *Rice News-Teller*, 1958, 6 (4), 9.
3. Nakamura, S., *Proc. Internat. Seed. Test Asso.*, 1963, 28, 57.
4. Roberts, E. H., *J. Expt. Bot.*, 1961, 13, 75.
5. Samantarai, B. and Dubey, A. S., *Proc. Indian Sci. Cong.*, 1953, Part III.
6. Tukey, H. B. and Carlson, R. F., *Plant Physiol.*, 1945, 20, 505.

A NEOLITH FROM SON VALLEY

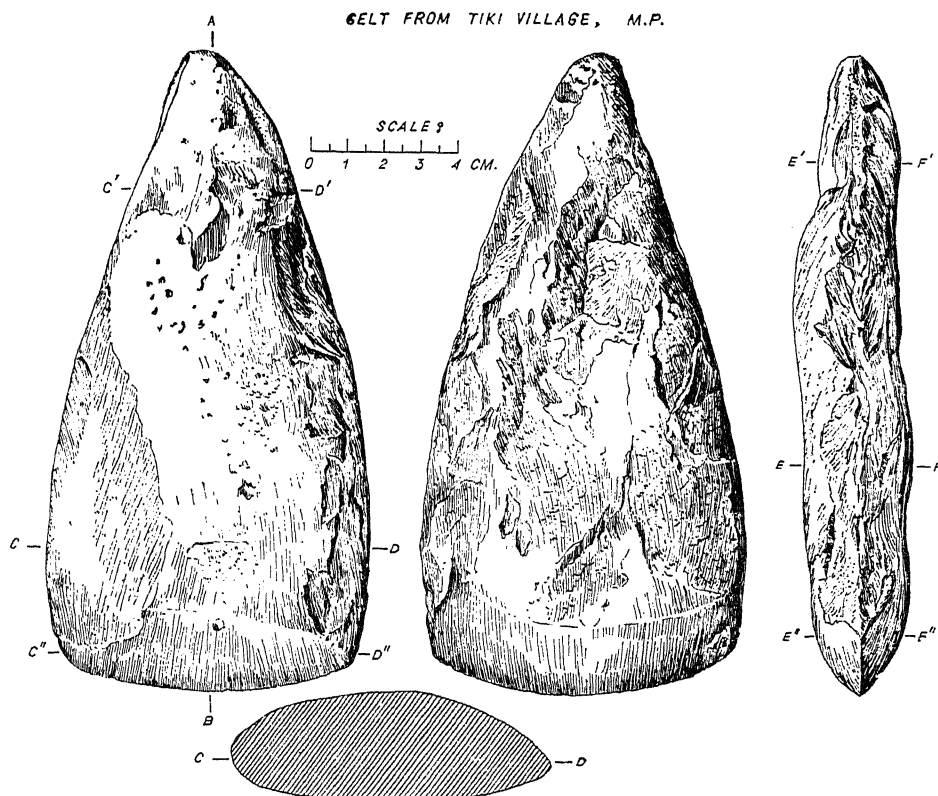
THE present note describes a new neolithic stone-axe (celt) collected from a locality half a mile south of the village Tiki ($81^{\circ} 22'$: $23^{\circ} 56'$) in Sahdol District, Madhya Pradesh; twelve miles north-east of the present course of Son River, on the road connecting Rewa and Sahdol. The best route to this locality is via Rewa. This lone trait of prehistoric culture was discovered¹ in March 1965.

The country around Tiki is formed of red clay and soft sandstone; flanked in the north

and north-west by high Vindhyan hills and in the south by Deccan trap hills. The slightly undulating tract around Tiki, famous for reptilian and amphibian fossil remains, has hardly any covering of soil. Small patches of recent to sub-recent gravel deposits here and there, mostly weathered and disintegrated, support a scanty vegetation. The artifact was found lying on the red clay ground among weathered fossil bones of Triassic age and pebbles of quartz and quartzite. A good search by the field party did not yield a second specimen, which indicates the rarity of such implements in this area.

(a) *Composition*.—The specimen is composed of very fine-grained, hard, compact greenish-black basalt, a rock which occurs in great thickness in the south of the area.

(b) *Measurements*.—Max. length: 19.1 cm. (A-B); max. breadth: 8.8 cm. (C-D); breadth near pole: 4.5 cm. (C'-D'); breadth near cutting edge: 8.0 cm. (C''-D''); max. thickness: 2.9 cm. (E-F); thickness near pole: 2.25 cm. (E'-F') and thickness near working edge:



Tiki celt: Three views of the (a) dorsal, (b) ventral and (c) lateral surfaces of the specimen, with cross-sectional outline. Measurements between the points designated by A, B, C, C', C'', D, D', D'', E, E', E'' and F, F', F'' have been shown in the text.

2.3 cm. (E"-F"). Letters given in parenthesis may be compared with those given in the figure-drawings of the celt. Weight: 662.7 gm.

(c) *Patination*.—Differential chemical alteration (patination)² is distinctly discernible on several spots over either of the surfaces, marginal faces, especially on terminal lateral profile towards the pole of the specimen. A distinguishing elongated patinated scar (3.4 cm. in max. length) with brownish hue covers the left margin at the pointed butt-end.

(d) *Shape and Size*.—The characteristic shape of the specimen is triangular in external form but cross-section reveals more or less lenticular profile from top view. The specimen is remarkable for its massive size and weight.

(e) *Workmanship*.—Neolithic techniques for tool-making are clearly discernible in this artifact. The specimen exhibits chipping and pecking on the surfaces and margins. High degree of polishing on both surfaces near the cutting-end is remarkable. On the convex (dorsal) surface several deep and shallow flake-scars are noticeable along with marks of weather-actions. Lateral margins vary in thickness. Left margin produces a thinner profile in comparison to the thicker right margin on which marks of frequent chipping are present. The ventral surface bears a flat and depressed look. The polar end is somewhat tapering with a blunt finish.

Thanks are expressed to Sarvasri T. S. Kutty, S. K. De and B. K. Sinha for their help.

Indian Statistical Inst., KANTI PAKRASI.
Calcutta-35. TAPAN ROYCHOWDHURY.
May 30, 1966.

1. Second author collected the specimen from the area mentioned.
2. Goodwin, A. J. H., "Chemical alteration (patination) of stone," in R. F. Heizer and S. F. Cook (Eds.), *The Application of Quantitative Methods in Archaeology*, Quadrangle Books, Chicago, 1960.

A NOTE ON THE OCCURRENCE OF SOME INTERESTING IGNEOUS ROCKS IN TEN-MUDIYANUR AND EDATHANUR, CHENGAM TALUK, NORTH ARCOT DISTRICT, MADRAS STATE

DURING the course of the mineral survey in North Arcot District the authors came across a small deposit of magnesite amidst a very interesting suite of crystalline rocks. The deposit found in an area of 15 acres is situated about 1½ miles south-south-west of Ten-Mudiyanur (12° 7' 30": 78° 57' 00") in the Topographic Sheet 57 L/16 of the Survey of India. It is about 12 miles south-west of

Tiruvannamalai, south of an irrigation canal of the Sathanur Dam Project.

This occurrence shows a wide variety of igneous rocks ranging from extremely basic types such as peridotites and dunites, to unsaturated rocks such as corundum syenites and also acidic types such as granites and pegmatites which seem to have been formed through a process of differentiation. These igneous rocks are surrounded by charnockitic rocks and a search in the surrounding area has not revealed any other outcrops similar to this occurrence. This is perhaps the only occurrence, at least in this part of South India, where such a wide range of igneous differentiated rocks can be seen within such a small compass. The relationship of this igneous suite to the charnockitic rocks has not been determined, but the field indications are that this is probably an emplacement of a later age. The other alternative, *viz.*, that it is a xenolith within the charnockitic rocks has not been supported because no other similar patch of unassimilated rocks has been found so far in the neighbourhood.

The general trend of all the formations in the area is in a NE-SW direction with steep north-westerly or vertical dips. The magnesite-bearing ultrabasic rocks have a rough ellipsoidal form and consist essentially of dark-greenish coloured dunites and peridotites. These are surrounded by extremely coarse pyroxenites (hypersthénites) on one side and corundum-bearing syenites at the other (north-eastern) side. Pink granites and coarse pegmatites are found to the east of the corundum-bearing rocks. The corundum crystals at places show a rough alignment, probably indicative of flow. The dunitic rocks bear within them criss-cross veins of magnesite ranging in width from two inches to nearly one foot. The width of the veins appear to become larger at deeper levels, probably indicative of their having been formed by hydrothermal carbonate solutions. Small pieces of serpentine are associated with the magnesite. The magnesite itself appears to be of fairly good quality; the hard brilliant white varieties are found mixed up with soft earthy varieties. The presence of slickensiding in magnesite and serpentine indicates the presence of shear planes and crush zones. A sample of magnesite collected from this area analysed about 47% of magnesia (MgO). The mineral is being worked by a private entrepreneur who has mined this deposit to a depth of 20 to 25 feet by opening a few pits.

State Geology Branch, V. GOPAL.
Madras, April 20, 1966. JACOB KURIYAN.

REVIEWS AND NOTICES OF BOOKS

Symposia of the International Society of Cell Biology (Vol. 4)—*The Use of Radioautography in Investigating Protein Synthesis*. R. Brown and J. F. Danielli, Symposium Editors, Society for Experimental Biology. Edited by C. P. Leblond and Katherine B. Warren. (Academic Press, New York and London), 1966. Pp. x + 348. Price 144 sh.

The Symposium reflects the most recent advances in studies of protein synthesis at cellular and subcellular levels. Participants included physicists, biochemists, cytologists, histologists, and pathologists. The common denominator of this group was an interest in studying protein synthesis through the use of isotopically labelled amino-acids, employing the technique of radioautography or autoradiography. The technique, which involves the use of special nuclear track emulsions, allows for localizing proteins at their specific sites of synthesis and for determining their subsequent course or fate in cells or tissues. This provides for assessing protein synthesis in relation to fundamental processes of cell renewal and differentiation, secretion, and to the turnover of intracellular and extracellular proteins.

Volume 4 includes sections on: Techniques and Methods; Protein Synthesis in Nucleus; Protein Synthesis in Cells of Various Types; Secretory Processes.

C. V. R.

Human Nutrition and Dietetics (Third Edition).

By Sir Stanley Davidson and R. Passmore. (Publishers: E. and S. Livingstone Ltd., Edinburgh and London), 1966. Pp. x + 864. Price 95 sh. Postage 5 sh.

The first edition of this work published in the year 1959 was reviewed in *Current Science*, 1960, 29, 199. The second edition published in 1963 was reviewed in 1963, 32, 478. In the present edition, every section of the book has been carefully revised and many of the chapters have been largely or completely rewritten. The bibliography has been brought up-to-date. Despite the addition of much new material, the size of the book has been reduced by some 25 pages.

The many excellent features of the work resulted in the first edition establishing itself as the standard text-book for students of nutrition, and this position has been maintained

ever since. It is, however, not superfluous to draw attention here to the special qualities which gained for the book its well-deserved popularity, viz., the wide coverage of subjects, the pleasing style and clarity of the presentation and, above all, the balance maintained between the exposition of the theoretical aspects of the subject and its practical application in various fields of great importance, viz., the prevention and treatment of disease and the dietetic problems which arise in the varied circumstances of human living.

C. V. R.

Chemistry and Physics of Carbon (Vol. I).

Edited by Philip L. Walker, Jr. (Marcel Dekker, Inc., New York), 1966. Pp. xv + 382. Price \$13.75.

Over the last twenty years, the boundaries and contents of the area denoted as the Physics and Chemistry of Carbon have become reasonably well delineated. Carbon is truly an "Old but new material". In the past twenty years, industry has made major improvements in the properties of carbons that are used in "old" applications such as electrodes for electric arc furnaces, carbon blacks for filler material, and activated carbons for gas and liquid purification processes, and has developed "new" carbons such as synthetic diamonds, massive pyrolytic graphite, and carbon-base fiber reinforced plastics. This progress has not been recorded well in scholarly reviews and it is now time for monographs with a truly interdisciplinary approach.

The book contains the following chapters written by Organic Chemists, Physical Chemists, Physicists, Electrochemists, Chemical Engineers and Fuel Technologists, each author having international reputation: 1. Dislocations and Stacking Faults in Graphite, by S. Amelinckx, P. Delavignette, and M. Heerschap; 2. Gaseous Mass Transport within Graphite, by G. F. Hewitt; 3. Microscopic Studies of Graphite Oxidation, by J. M. Thomas; 4. Reactions of Carbon with Carbon Dioxide and Steam, by Sabri Ergun and Morris Mentser; 5. The Formation of Carbon from Gases, by Howard B. Palmer and Charles F. Cullis; and 6. Oxygen Chemisorption Effects on Graphite Thermo-electric Power, by P. L. Walker, Jr., L. G. Austin, and J. J. Tietjen.

C. V. R.

Text-Books of College Chemistry. (Published by McGraw-Hill Book Company.)

Chemistry: Principles and Properties. By M. J. Sienko and R. A. Plane. 1966. Pp. 622.

This is a suitable modern text-book for first-year college course in chemistry. With the increase in the level of chemistry instruction in schools, the entrants to college come with a better background knowledge and are prepared to receive a deeper course of study of the fundamentals of the subject. The book is aimed at providing such a course. The contents may be divided into two parts. The first part (Chapters 1-13) in which the material is presented in order of increasing complexity, atoms, molecules, gases, condensed phases, solutions, electrochemistry, reactions and chemical thermodynamics. The second part of several chapters is descriptive chemistry of the elements according to the well-known groups. The last chapter is devoted to nuclear structure and radioactivity. The text contains a number of solved examples and questions at the end of each chapter.

Physical Chemistry (Second Edition). By G. M. Barrow. 1966. Pp. 843.

The first edition of Prof. Barrow's *Physical Chemistry* published four years ago was well received as a text-book for undergraduate students of chemistry. The second edition besides bringing the information up-to-date, has reorganised the material into more coherent chapters. Some topics have been revised and many new topics have been included. Among these may be mentioned the following: thermodynamics of aqueous solutions of electrolytes including open systems and partial molal quantities; molecular orbitals and bonding; heat of vapourisation and intermolecular forces; ionic crystals and crystal forces.

Chemical Kinetics (Second Edition). By K. J. Laidler. 1966. Pp. 566. Price \$13.00.

The more important facts and theories relating to the rates with which chemical reactions occur are presented in this book in a connected and easily understandable form. Intended mainly for University students, a basic knowledge of thermodynamics and kinetics is assumed on their part. In fact the present edition differs from the first edition in that the chapters dealing with the elements of thermodynamics and kinetics in a detailed manner have been curtailed, and the book has been completely rewritten bringing it more up-to-date in presentation. The subject-matter is dealt with in the following ten chapters: The Analysis of

Kinetic Results; The Measurement of Reaction Rates; The Mechanisms of Elementary Processes; Elementary Gas-Phase Reactions; Elementary Reactions in Solutions; Reactions on Surfaces and in the Solid State; Complex Reactions; Some Complex Reactions in the Gas Phase; Homogeneous Catalysis; Some Reaction Mechanisms in Solution.

A carefully selected number of problems is included at the end of nearly all chapters to enable serious students understand the fundamental principles of the subject. A bibliography of original literature on the subject made up-to-date is appended for further reading.

Advanced Concepts in Physical Chemistry. By E. D. Kaufman. 1966. Pp. 271. Price \$9.95.

Topics of modern Physics relating to structure and energy of atoms and molecules, individually and also in assemblies, form an essential part of advanced teaching of general physical chemistry in colleges. Many specialised text-books are available for each such topic for intensive theoretical study. But a book which gives a connected account of the relevant topics of interest to students of physical chemistry, providing detailed mathematical derivations to clearly understand the fundamental principles involved will be a welcome publication. This is what Professor Kaufman's book does. It introduces the undergraduates to the basic concepts in the areas of quantum mechanics, spectroscopy, statistical thermodynamics and theoretical kinetics. The coverage is adequate and the treatment is lucid. A. S. G.

Vibrations: Theoretical Methods. By Yu Chen. (Published by Addison Wesley Publishing Co., Inc.), 1966. Pp. 285. Price \$9.75.

The book presents the theoretical methods most frequently used in the analysis of vibrations of linear mechanical systems. Methods of evaluating responses are developed, beginning with sinusoidal inputs and evolving to the most general types of excitations. The Laplace transform method as well as the modal method are used to study the vibrations of both discrete and continuous systems.

The development of the material is under the following chapter headings: Introduction; Analysis of Response to Periodic and Aperiodic Forces by Transform Methods; Lagrange's Equations and Hamilton's Principles; Theory and Application of Normal Mode; Systems with Viscous Damping; Matrix Theory and Methods; Vibrations of Continuous Systems; and Vibrational Methods.

A number of problems are given at the end of each chapter. The book will be suitable for engineering instruction at graduate level.

A. S. G.

Interpreted Infra-red Spectra (Vol. 2). By Herman A. Szymanski. (Plenum Publishing Corporation, 227, West 17th Street, New York, U.S.A.), 1966. Pp. 304. Price \$12.50. Size 27 cm. × 21 cm.

Although there are many books and recordings of infra-red spectra and their interpretation, data and correlations relating to alcohols and diols are somewhat limited, and in most cases confined to a comparatively few typical spectra. Hence this publication which presents a large number of alcohol and diol spectra in a manner which will enable the investigator to interpret data and evaluate suggestive correlations is a welcome addition to the literature on the subject.

The book contains a series of 260 infra-red spectral recordings of typical alkynes (13) and alcohols and diols (247) with all significant bands identified for easy recognition when met with in course of investigation. For each family of compounds vibrational analyses of typical compounds are presented, and correlation tables are given.

A cumulative index, arranged by empirical and structural formulæ, to the interpreted spectra in the first two volumes in this series has been appended. A conversion table for wavelengths in microns to wavenumbers and *vice versa* flanks the text on the two inside covers.

The spectra are strikingly exhibited and legended for easy identification of compounds.

A. S. G.

Hand-Books on Medicine and Surgery. (Lange Medical Publications, Meruzen Company Limited.)

1. **Physician's Hand-Book** (Fourteenth Edition). By M. A. Krupp, N. J. Sweet, E. Jawetz and E. G. Biglieri. 1966. Pp. 616. Price Rs. 16.87.
2. **Hand-Book of Surgery** (Third Edition). Edited by J. L. Wilson and J. J. McDonald, 1966. Pp. 723. Price Rs. 18.75.

These are two indispensable pocket companions for medical students and practitioners of medicine. *Physician's Hand-Book* is in its

Fourteenth edition and has been critically revised, reviewed and brought up-to-date. A new illustrated chapter on Selected Diagnostic and Therapeutic Procedure has been added. The *Hand-Book of Surgery* provides a concise summary of the essential features of the more common surgical disorders. It gives basic diagnostic information and discussions of non-operative management including essential details of preoperative and postoperative care.

The Meruzen Asian Editions are available from the Sole Distributors for India, The Kothari Book Depot, King Edward Road, Parel, Bombay-12.

Books Received

Botanical Monograph—Indian Fossil Pteridophytes. By K. R. Surange. (Publication and Information Directorate, New Delhi), 1966. Pp. 209. Price Rs. 23.00.

Experimental Nucleonics—An Introductory Course for Students. By B. Brown. (Iliffe Books Ltd., Dorset House, Stamford St., London S.E.), 1963. Pp. 245. Price 13 sh. 5 d.

An Introduction to Fluvial Hydraulics. By Serge Leliavsky. (Dover Publications, Inc., 180, Varick Street, New York-14, N.Y.), 1965. Pp. xii + 257. Price \$ 2.00.

Atomic Physics—An Atomic Description of Physical Phenomena. By G. P. Harnwell and W. E. Stephens. (Dover Publications, Inc., 180, Varick Street, New York-14, N.Y.), 1966. Pp. x + 401. Price \$ 2.50.

Valence and the Structure of Atoms and Molecules. By G. N. Lewis. (Dover Publications, Inc., New York), 1966. Pp. 172. Price \$ 1.50.

A Treatise on Bessel Functions and Their Applications to Physics. By A. Gray and G. B. Mathews. (Dover Publications, Inc., New York), 1966. Pp. xiii + 327. Price \$ 2.25.

Infinite Matrices and Sequence Spaces. By R. G. Cooke. (Dover Publications, Inc., New York), 1966. Pp. xiii + 347. Price \$ 2.50.

An Introduction to Abstract Algebra. By C. C. Macduffee. (Dover Publications, Inc., New York), 1966. Pp. vi + 303. Price \$ 2.25.

About Plants—Topics in Plant Biology. By F. C. Steward. (Addison Wesley Publications Co., London W. 1), Pp. x + 174. Price 23 sh.

Technical Calculus with Analytic Geometry. By A. J. Washington. (Addison Wesley Publications Co., London W. 1). Pp. viii + 440. Price 51 sh.

ORGANIC CHEMISTRY

Revised Edition

By P. B. SARKAR, D.Sc., F.N.I.

Director of Technological Research
Indian Council of Agricultural Research

First Published 1942 12th Edn. 1965
Pp. 522 Medium 8 vo Rs. 9

"Heartly congratulations for the new edition. I have been recommending it to my students for the last 20 years."

B. PURI

Head of Chemistry Department, Government
College, Chittorgarh

ELEMENTARY PHYSICAL CHEMISTRY

By PROF. S. R. PALIT, D.Sc., F.R.I.C., F.N.I.
Indian Association for Cultivation of Science
Calcutta

Pp. 428 14th Edn. 1965 Rs. 7-50

A highly popular, up-to-date, concise text for Pass B.Sc. students.

INORGANIC CHEMISTRY

By A. K. DE, M.Sc., D.Phil.

Reader, Jadavpur University, Calcutta-32

3rd Edn. 1966 Rs. 12-00

"Congratulations. It can easily equal all of its kind in the field and excel many."

PROF. K. V. NAYAR

M.G. College, Trivandrum

PRACTICAL CHEMISTRY

By B. K. GOSWAMI, M.Sc.

Ex-Lecturer, Jadavpur University, Calcutta

Inorganic 3rd Edn. 1965 Rs. 6

Organic 2nd Edn. 1965 Rs. 4

All essentials against theoretical background.

INTERMEDIATE CHEMISTRY

By PROF. P. K. DUTT

Presidency College, Calcutta

Pp. 680 8th Edn. 1964 Rs. 10

Clear presentation; covers all-India Higher Secondary and University syllabuses, with organic supplement.

THERMODYNAMICS

(for Hons. and Post-graduate students)

By PROF. P. C. RAKSHIT, M.Sc., Ph.D.

Formerly Head of Chemistry Department
Presidency College, Calcutta

A lucid comprehensive treatment of the laws of thermodynamics and application of thermodynamic principles in physics and chemistry.

Medium 8 vo 1962 Rs. 12-50

GENERAL PHYSICS

15th Edition 1965 Rs. 6-75

A TEXT-BOOK OF SOUND

10th Edition 1964 Rs. 6-00

By T. M. MANDAL, M.Sc.

Late Professor, Vidyasagar College, Calcutta

Popular, precise, simple and thorough. Numerous worked out examples and university questions.

A TEXT-BOOK OF HEAT

(for junior students)

By M. N. SAHA, D.Sc., F.R.S.

AND

PROF. B. N. SRIVASTAVA, D.Sc., F.N.I.

Indian Association for the Cultivation of
Science, Calcutta

11th Edition 1962 Rs. 9

do. in Hindi 1960 Rs. 9

Most popular in India and abroad; covers 3-year degree course of Indian universities.

PRACTICAL PHYSICS

(For 3-year degree course)

By S. C. RAKSHIT, M.Sc.

Prof. of Physics, Vidyasagar College, Calcutta

1963 Medium 8 vo Rs. 5-00

Precise but concise; a complete guide.

GENERAL AND INORGANIC CHEMISTRY

(for 3-year degree students)

By P. K. DUTT

Gold Medallist

A standard work, covering all important aspects and modern developments.

Vol. I Rs. 8-00

Vol. II Rs. 8-00

Combined Vol. Rs. 15-00

SCIENCE BOOK AGENCY

P-133 B, LAKE TERRACE, CALCUTTA-29

AN ANALYTICAL TECHNIQUE AS POWERFUL AS THE INFRARED

DISCOVERED experimentally in 1928, and resting on solid theoretical foundations, the spectroscopy of Raman scattering remained for two decades as one of the "finest presents that the physicists had made to the chemists". At a time when the techniques of infrared absorption were accessible only to the very advanced research laboratories, the Raman effect, with its elegant theory of virtually bringing the study of the infrared to the spectroscopy of the visible region, had helped in establishing the structure of thousands of molecules. But the appearance in the market of convenient, automatic, "press-button" infrared spectrophotometers is slowly putting into disuse the Raman spectrographs, and, in fact, these with their conventional mercury burners have the unenviable prospect of figuring more or less as museum pieces only.

However there is no theoretical justification for this disfavour. Infrared and Raman techniques are essentially complementary, and the two together are necessary for establishing the complete spectrum of a molecule. The unique merit of the Raman technique is that it furnishes on a single spectrum information on a wide range of frequencies extending from the very near to the very far off in the infrared.

The reasons for the preference of the absorption methods are not far to seek. They are essentially of a practical nature. Early in the history of Raman spectroscopy accurate measurement of wavelengths of Raman lines was the chief concern of the experimentalists. Now, however, there is the added emphasis on the measurement of their intensities and polarisation which are necessary for a complete understanding of the physics and chemistry of molecules. Any design of a Raman spectrometer should be such as to obtain from it the maximum accurate information that the method itself is theoretically capable of giving. Extensive researches have been done on the requirements of the individual elements,—like the source, the sample cell and its geometry, the monochromator system and its optics, the photomultiplier tubes, the detector and its electronics, etc.,—which go to make up the spectrometer. The main problem designers of Raman spectrometers are confronted with is how to bring in one convenient and reliable set-up all these elements together. The recent discovery of the *Lasers*, sources of light by stimulated emission, has rekindled hope in this field, and one can confidently look forward to

a new era in Raman spectroscopy heralding the renaissance of an analytical technique as powerful as the infrared.

LASER AS RAMAN SOURCE

Lasers with their enormous intensity provide the specialists in Raman spectroscopy the source which is ideally suited to their exacting needs. The conventional monochromatic sources in use previously, namely, mercury tubes at low or medium pressures, produced in the scattering sample only a low density of photons which necessitated the illumination of a great volume of the substance to facilitate any measurement of the Raman effect. On the other hand, the lasers contain in narrow beam a highly augmented density of photons which enables one to excite an intense scattering in a sample of very small volume.

The laser provides other advantages which are no less important. Thus its extreme monochromaticity permits study of spectra of a high degree of resolution. Its parallelism and coherence properties lead to absence of a continuous background and stray parasitic illumination; a higher detectivity is thereby ensured, and observation of scattered rays is possible not only of very weak intensity but also those which are in the immediate vicinity of the exciting radiation. Finally, the high degree of polarisation of the laser beam is a valuable asset for the establishment of molecular symmetries.

PRINCIPLE OF RAMAN SPECTROSCOPY

The Raman effect is the phenomenon of the change of wavelength, accompanied by a partial depolarisation, observed in the scattering of light by molecules or by crystals. In order to study this phenomenon a transparent and homogeneous substance is illuminated by a beam of intense monochromatic light of frequency ν_0 . The analysis of the scattered light by a suitable spectrometer shows, in addition to the exciting radiation (Rayleigh effect), radiations of feeble intensity of frequencies $\nu_0 + \nu_1$, $\nu_0 + \nu_2$, ... $\nu_0 + \nu_n$ (anti Stokes' rays), and $\nu_0 - \nu_1$ (Raman rays), constituting the Raman spectrum "characteristic of the scattering substance". The values of ν_1 , ν_2 , ... ν_n , which are independent of the exciting radiation ν_0 , are frequencies generally belonging to the rotation spectrum or the vibration spectrum of the molecule.

The "active" frequencies in the Raman effect correspond to movements which are accompanied by a change of the molecular polarisation,

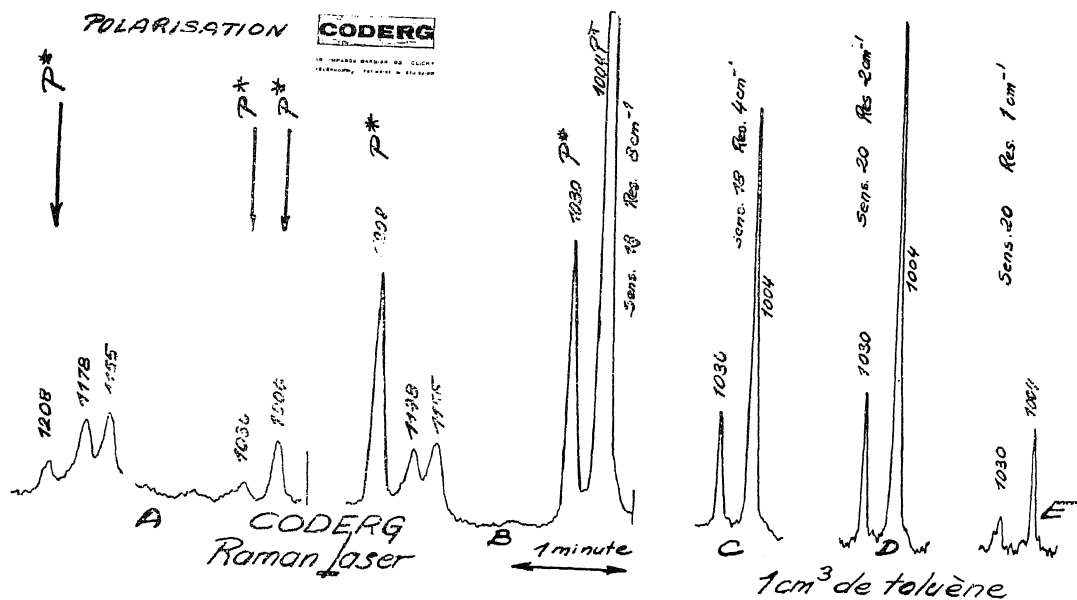


FIG. 1

while the frequencies observed in the infrared absorption are related to changes in the dipole moment.

The intensity of the Raman spectrum varies as the fourth power of the frequency. However, when a coloured substance is excited in the vicinity of an electronic absorption band, a considerable enhancement of the intensity is observed which is caused by the "resonance effect".

The measurement of the state of polarisation of the scattered light enables a classification of the different frequencies to be made: the rays that are polarised are due to symmetrical vibrations, and the rays that are unpolarised to antisymmetric or degenerate vibrations.

A RAMAN SPECTROMETER COMPLETELY DESIGNED FOR LASER EXCITATION

The properties of the laser that make them different from the classical Raman sources (Mercury, Helium, etc. lamps) are (1) their single frequency characteristics; (2) their high monochromaticity ($\Delta\mu \sim 0.004 \text{ cm}^{-1}$ for He: Ne lasers); (3) their parallelism (divergence less than $30'$ arc); (4) the high degree of polarisation of the exciting light; (5) the high instantaneous power attainable (for pulsed lasers); and (6) the high degree of coherence. Much of the success of the laser as a practical Raman source will depend on the kind of geometry used for the cell containing the sample, and on the light gathering efficiency of the optics employed.

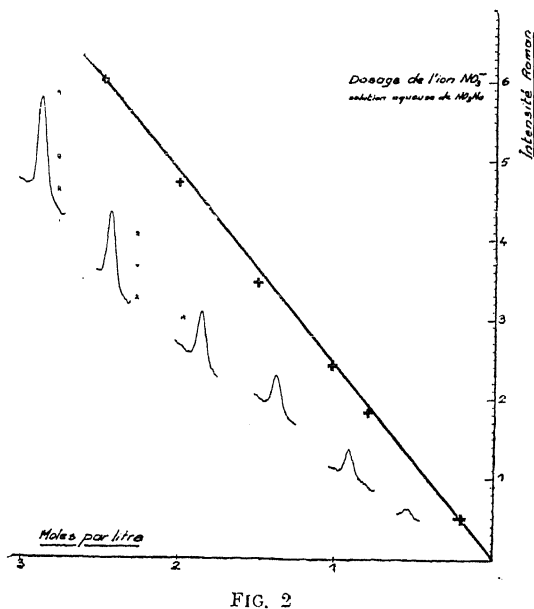


FIG. 2

To this day no commercial apparatus has fully taken advantage of all the qualities of the lasers for recording the Raman spectra. The CODERG (15, Impasse Barbier, 92-Clichy-France) have been trying to fill this lacuna, and with the help of the Comité "Instruments de mesure" and the "Délégation Générale à la Recherche Scientifique et Technique" they have succeeded in constructing a Laser Excitation

Raman Spectrometer that can stand comparison with any industrial infrared spectrophotometers, both with respect to the convenience of use and reliability, and with respect to the optical qualities. In this equipment the optical, mechanical and electronic elements have been specially designed to take into account the properties and the special geometry of the laser beam. The source is a He: Ne laser 50 mW 6328 Å (or Argon or ionized Krypton). The optics consist of a double monochromator—a grating followed by either a grating or a prism. The manufacturers claim that this equipment which is rapid, true, and automatised should

satisfy the most exacting researcher as well as the routine analyst.

The possibilities offered by this equipment are illustrated by the two figures reproduced here. Figure 1 presents a part of the toluene spectrum. The effect of polarisation of the lines 1208, 1030 and 1004, as well as the different resolutions on the last two lines could be seen. It is to be noted that the entire set of these results were obtained in about 10 minutes. Figure 2 represents a quantitative estimation of NO_3^- ion, in an aqueous solution of NaNO_3 at different concentrations. In this case the entire set of results were obtained in 60 minutes.

SPECTROPHOTOMETRIC STUDIES OF MOLYBDENUM (VI) COMPLEX OF 3-PHENYLDAPHNETIN

B. D. JAIN AND RAJ KUMAR

Department of Chemistry, University of Delhi, Delhi-7

THOUGH the most common procedure for the colorimetric determination of molybdenum is based upon its colour formation with thiocyanate in presence of stannous chloride,¹ several phenolic compounds, e.g., catechol,² protocatechuic aldehyde,³ disodium-1, 2-dihydroxybenzene-3, 5-disulphonate,⁴ gallic acid⁵ have also been employed. Recently esculetin (6, 7-dihydroxycoumarin) and its derivatives have been used⁶ because they produce orange-coloured aqueous ethanol-soluble complexes with molybdenum. The present study deals with the complex of this metal with another dihydroxycoumarin, 3-phenyldaphnetin, i.e., 3-phenyl-7, 8-dihydroxycoumarin. Daphnetin derivatives have been used for a long time as mordant dyes, they can be expected to form stabler complexes useful for analytical work.

3-Phenyldaphnetin in ethanolic solution forms a yellow complex with molybdenum, which is soluble in 40% ethanol. This complex has molar composition of 1:1 and obeys Lambert-Beer's law, at 400 m μ , between the concentration limits of 1.7 to 5.7 ppm. of molybdenum in solution.

EXPERIMENTAL

3-Phenyldaphnetin was prepared by the method of Bargellini⁷ as improved by Krishnaswamy,⁸ and its standard ethanolic solution was used. Standard molybdenum solution was prepared using sodium molybdate (Analar BDH).

Beckman pH-meter model H2 was used for measurement of pH, which was adjusted with hydrochloric acid and sodium hydroxide.

Unicam spectrophotometer model SP 600 was used for spectrophotometric measurements.

Absorption spectrum of the complex.—The complex showed maximum absorption at 400–410 m μ between pH 1–7, thereby indicating the presence of only one complex. In this pH range of 1 to 7, the complex showed maximum absorption at pH 6, at 400–410 m μ . The subsequent studies were carried out at 400 m μ and at pH 6.

Minimum amount of the reagent for full colour development.—The study of the optical density of a series of solutions, containing the metal and the reagent in the ratio varying from 1:1 to 1:13, showed that the full colour development required a tenfold concentration of the reagent. During the subsequent studies, however, the molar ratio of the reagent to metal was maintained at 12.

Molar composition of the complex.—The molar composition of the complex was determined employing three different methods:

- (a) Job's method of continuous variation⁹: This gives a composition of 1:1 as is indicated in Fig. 1.
- (b) Mole-ratio method¹⁰: The molar composition of the complex was also determined by the mole-ratio method of Harvey and Manning. The results indicate the composition to be 1:1 (Fig. 2).
- (c) The composition was finally verified by Asmus method.¹¹ The straight line at $n=1$ shows the composition to be 1:1 (Fig. 3).

The complex was found to be negatively charged by passing it through ion-exchange resins.

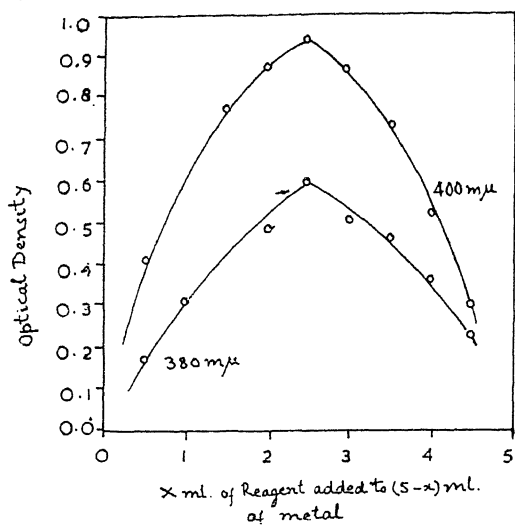


FIG. 1

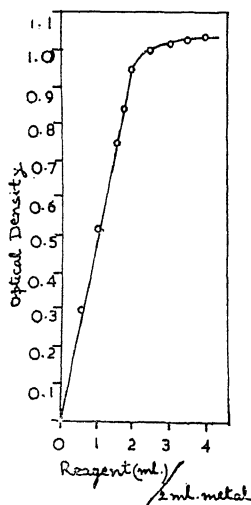


FIG. 2

Further studies regarding the structure of the complex are in progress.

Stability of the complex.—The optical density of the complex has been found to remain constant for 12 hours. The complex obeys Lambert-Beer's law between the concentration limits of 1.7 ppm to 5.7 ppm of molybdenum in solution. Stability constant of the complex was determined by two different methods:

- (1) From the curve of the molar composition of the complex, the value of α , the degree of dissociation of the complex

was calculated. This value of α was then employed to calculate the value of the stability constant. This gives the average value of $\log K$, at an ionic strength of 0.2 M (maintained by the addition of KCl solution) in 40% alcoholic medium, at $32^\circ \pm 2^\circ \text{C.}$ to be 4.5 ± 0.2 .

- (2) The intercept made by the straight line with the Y-axis in Asmus' method (Fig. 3) is given by $-(b_0/v)^n$. $1/K_c$ where b_0 is the molar strength of reagent solution employed, v is the final volume made, K_c is the dissociation constant and $n=1$ in this case. This method gives the value of $\log K$, under the conditions mentioned above (except that ionic strength in this case was not kept constant), to be 4.39.

Interference due to foreign ions.—Ce (III & IV), Fe (II & III), titanium (IV), thorium (IV), tungsten (VI), vanadium (V), uranium (VI), niobium (V) cause serious interference even when present in small quantities.

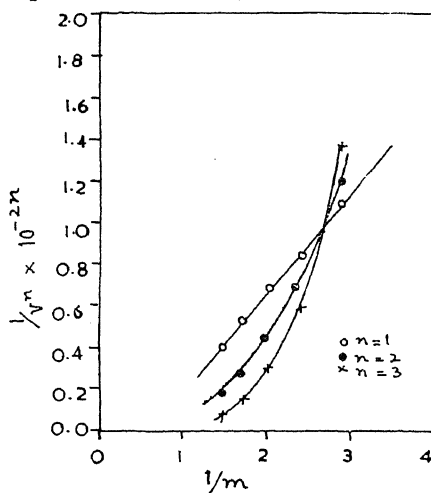


FIG. 3

Among the anions studied acetate, sulphate and thiosulphate did not cause interference. Citrate and oxalate could be tolerated as far as the amount present was less than that of molybdenum itself. Phosphate and fluoride do not cause interference even when present in 100-fold and 30-fold concentrations respectively.

Recommended procedure for estimation.—An aliquot of molybdenum solution containing not more than 5.7 ppm of molybdenum is mixed with the required amount of the reagent. The pH of the resultant solution is adjusted to the appropriate value and its optical density

measured, using the reagent, under corresponding conditions as reference. Concentration of molybdenum can then be determined from the calibration curve obtained earlier using solutions of known strength.

SUMMARY

3-Phenyldaphnetin (3-phenyl-7, 8-dihydroxy-coumarin) in ethanolic solution forms aqueous alcohol soluble yellow complex with molybdenum. The complex obeys Lambert-Beer's law between 1.7 ppm to 5.7 ppm of molybdenum in solution and has the composition of 1:1. Interference due to various ions has been studied. Stability constant of the complex under the experimental conditions is 4.5 ± 0.2 .

ACKNOWLEDGEMENT

The authors are grateful to Prof. T. R.

Seshadri, F.R.S., for his keen interest and helpful discussions.

1. Crouthamel, C. E. and Johnson, C. E., *Anal. Chem.*, 1954, **26**, 1284.
2. Seifter, S. and Novic, B., *Ibid.*, 1951, **23**, 188.
3. Shapiro, M., *Zhur Anal. Khim.*, 1951, **6**, 371; *Z. anal. Chem.*, 1953, **137**, 235.
4. Will, F. and Yce, J. H., *Anal. Chim. Acta*, 1953, **8**, 546.
5. Varde, M. S. and Athavale, V. T., *Proc. Ind. Acad. Sci.*, 1955, **44 A**, 228.
6. Jain, B. D. and Singh, H. B., *Indian J. Chem.*, 1963, **1**, 369.
7. Bargellini G., *Gazz.*, 1927, **57**, 457.
8. Krishnaswamy, N. R., *Ph.D. Thesis*, Delhi University, 1962.
9. Job, P., *Ann. Chim.*, 1928, **9**, 113.
10. Harvey, A. E. and Manning, D. L., *J. Amer. Chem. Soc.*, 1950, **72**, 4488.
11. Asmus, E., *Z. anal. Chem.*, 1960, **178**, 104.

ARE TENDRILS OF VITACEAE AXILLARY?

J. J. SHAH AND Y. S. DAVE

Department of Botany, Sardar Patel University, Vallabh Vidyanagar

TENDRILS of Vitaceae are of considerable interest from morphological and ontogenetic view-points. The tendril is considered a modification of an entire shoot apex or a part of the shoot apex due to dichotomy or unequal division of the shoot apex (refer Shah¹ for detailed references). If the tendril is homologized with a lateral branch, several types of morphogenetic development are considered. It is stated that the tendril has developed from (a) an extra-axillary bud opposite to the leaf, (b) an axillary bud with its axillant leaf aborted, (c) an axillary bud originating at the node below and carried upward by intercalary growth of the internode, (d) a branch of the aborted prophyll of the bud axillant to the leaf opposite the tendril which rotates around the vine-shoot through 180° to have an opposite position and (e) a tendril is a composite structure consisting of a "hypoclade" bearing a displaced leaf of the main stem. The bud axillant to this leaf is differentiated as the other part of the tendril (Shah,¹ Chadeaud,² Bugnon,³ Millington⁴).

Shah¹ discussed these various interpretations and on the basis of ontogenetic study, he concluded that the tendril and the inflorescence of *Cissus* (and perhaps of other genera of the Vitaceae) are interrelated morphological organs whose development from the extra-axillary bud meristem depends upon the vegetative and reproductive phases of the shoot. Recently Millington⁴ interpreted the tendril of *Parthenocissus*

inserta as a modification of an axillary bud of type C as mentioned above. The present communication deals with this interpretation along with our observations based on the ontogenetic studies of adult shoot apices of *Parthenocissus quinquefolia*, Planch (obtained from the Arnold Arboretum), *Cayratia carnosa*, Gagnep., *Cissus rotundifolia*, Vahl., and *Vitis japonica*, Thumb. About 26 species of the Vitaceae obtained from U.S.A., Canada and India are under investigation.

The general arrangement of tendrils and leaves in the investigated species, including *P. inserta* is illustrated in A. According to Millington,⁴ T₁, T₄ are lower and T₂, T₃ are upper tendrils. The tendril T₁, T₂, T₄ and T₅ is a modification of the bud axillant to leaf L₁, L₂, L₄ and L₅ respectively and carried upward by an intercalary growth of the internode so as to lie exactly opposite the leaf above. The ontogenetic evidences put forth by him are as follows:

(a) The tendril is initiated at the second plastochron. It is axillary in origin though its position at the time of initiation is at the flank meristem and its final displacement is extra-axillary.

(b) The bud meristem of a tendril-less leaf, L₀, and the tendril meristem supposed to be axillant to this leaf (T₁ and L₁, T₄ and L₄ in A) are initiated simultaneously forming a "tendril-bud complex" (of T and AX in C) from which

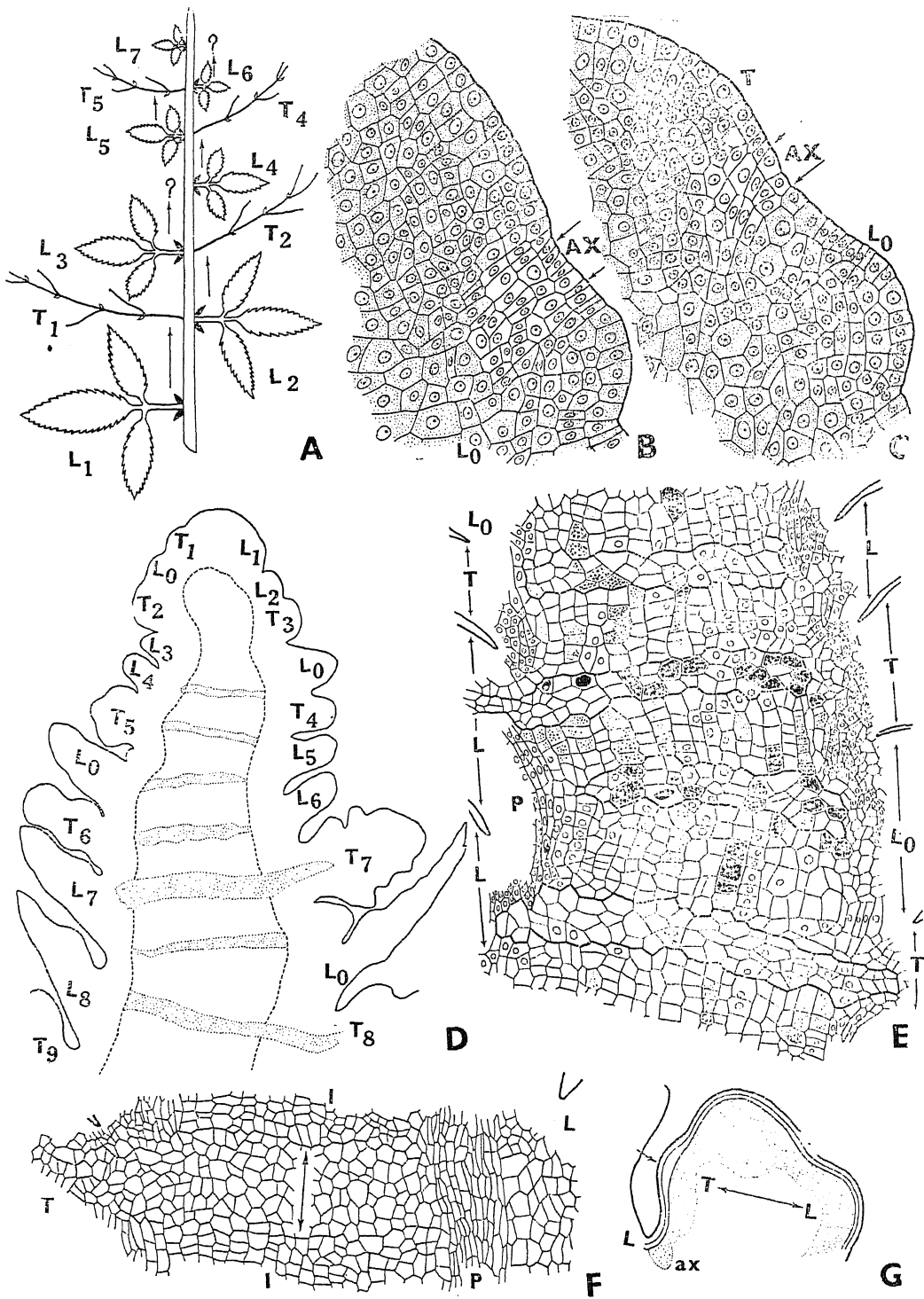


FIG. 1. A. A schematic diagram of the shoot showing the arrangement of leaves and tendrils. The arrow points to the tendril supposed to be axillant to the leaf below and question mark shows absence of any tendril for that leaf at the next higher node. B and C. L.s. shoot apex, $\times 417$. D and E. L.s. shoot tip, *Cayratia carnosae*, showing stippled nodal plate and its relation with the tendril and leaf of the

same node, $\times 67$. E. Enlarged diagram showing nodal and internodal tissues, $\times 133$. F. *Parthenocissus quinquefolia*, nodal plate at the level of tendril insertion, $\times 133$. G. L.s. shoot apex, *Cissus rotundifolia*, $\times 133$. (AX, axillary bud; I, internode; L, Leaf; L₀, Leaf at tendril-less node; P, procambium; T, tendril).

the bud and the tendril are later differentiated. The tendril is carried upward to an extra-axillary position at the node above by intercalary growth of the internode. The tendril-bud complex has a common provascular trace.

(c) The distinct group of cells at the node forms a plate or diaphragm which lies below the level of insertion of the tendril.

In a constant tendril pattern as illustrated in A, according to Millington,⁴ each tendril belongs to the leaf situated at the node below. It also means that every leaf at its second plastochron position should subtend the tendril meristem. But as shown in A, leaves L₂ and L₃ have no tendrils above their nodes. Similarly leaf L₂ (not labelled) in Fig. 5 and L₃ (not labelled) in Figs. 8 and 9 do not subtend any axillary tendril primordium in *Parthenocissus inserta* (Millington⁴). The morphogenetic situation at the shoot apex in which some leaves will be with or without their axillant tendril primordium has remained inexplicable.

The nodal and internodal tissues are not distinctly differentiated in the pith region near the shoot apex. The positional relationship of the nodal plate *vis-a-vis* the leaf and the leaf-opposed tendril at lower nodes is shown in D, E and F. It indicates that the tendril and the leaf opposite to it belong to the same node. The pith of the tendril and the axis is in continuation at this level and the extension of the nodal plate tissue is a connecting link (nodal plate in T₇ and T₈ in D). All possible evidences show that the positional relationship of the tendril and the leaf concluded by Millington⁴ on the basis of the nodal plate requires reconsideration.

In *Cayratia carnosa*, the initiation of the tendril is not related to the leaf below (Shah¹). In the early stages, a constriction separates the tendril primordium from the axillary bud meristem and its subtending leaf below. The nature of development of the reproductive and vegetative buds from a common bud meristem of L₀ leaf in *Cayratia carnosa* has close bearing on the initiation and morphogenetic relationship of the tendril (Shah⁵). Unfortunately Millington⁴ has not studied the detailed ontogeny of the axillary bud in *P. inserta*. In *C. carnosa*, the initiation of the bud meristem occurs at the first node before the tendril primordium supposed to be associated with the axillant leaf below as in *P. inserta* is initiated.

In *P. quinquefolia*, the bud meristem (AX in C) axillant to leaf L₀ is differentiated and lightly stained. Periclinal divisions in the second layer indicate initiation of the tendril, T. The so-called tendril-bud complex, axillant to leaf L₀ is absent. In *Vitis japonica* tendril initiation is hardly observed at this stage in B. In *Cissus rotundifolia* a histogenic situation parallel to *P. inserta* is present but bud meristem (aX in G) is lighter stained and distinctly differentiated from the adjacent tendril buttress, T. Moreover periclinal divisions initiating the vertical growth of the tendril (arrow at T in G) occur away from the bud meristem. Photomicrograph of Fig. 9 probably represents a similar histogenic pattern in *P. inserta*, though interpreted differently by Millington.⁴

The general ontogenetic stages of development of the tendril in *P. inserta* appear to be similar to those of the investigated species. It is necessary to investigate the ontogeny of axillary bud meristem if the origin of the tendril is to be interpreted axillary. If the bud and tendril meristem is initially of one complex, either of its meristem should differentiate as an accessory bud. According to Millington,⁴ every tendril-less leaf will subtend a tendril-bud complex. But as referred above this leads to an inexplicable ontogenetic situation at the shoot apex for certain leaves subtending only axillary bud.

There is initially a single provascular trace of the tendril which in its further development differentiates into three trace strands (Shah⁶). No common vascular trace for the tendril-bud complex as reported by Millington,⁴ but not supported by any evidence, is observed.

On the basis of ontogeny, therefore, the most acceptable interpretation of the Vitaceae tendril is that morphologically it represents an extra-axillary lateral branch as in many Cruciferae, Compositae, Graminae and other families. It is admitted that thorough ontogenetic studies involving work on seedling apex and onward to the mature apex on Vitaceae are necessary for a complete understanding of this problem.

1. Shah, J. J., *Proceedings of the Summer School of Botany, Darjeeling*, 1962, p. 430.
2. Chadeaud, M. M., *C. R. Acad. Sci., Paris*, 1949, 228, 1660.
3. Bugnon, M. F., *Recherches sur la ramification des Ampélidacées*, Paris, 1953.
4. Millington, W. F., *Amer. J. Bot.*, 1966, 53, 74.
5. Shah, J. J., *Phytonorphology*, 1960, 10, 157.
6. —, *J. Indian bot. Soc.*, 39, 443.

LETTERS TO THE EDITOR

GENERALIZED MEAN-SQUARE
AMPLITUDES OF VIBRATION AND
SHRINKAGE EFFECT IN $\text{CF}_3\text{C} : \text{CH}$
AND $\text{CF}_3\text{C} : \text{CD}$

The molecules $\text{CF}_3\text{C} : \text{CH}$ and $\text{CF}_3\text{C} : \text{CD}$ possess C_{3v} symmetry¹ like methyl acetylenes, but the angles are not tetrahedral in these cases. In this investigation, the symmetry co-ordinates used are the same as those for methyl acetylenes² with the necessary correction for the deviation from tetrahedral symmetry. Using the method of Morino and Hirota,³ expressions for the generalized mean-square amplitudes are

derived and utilized for evaluating the numerical values given in Table I. The generalized mean-square amplitudes are important in connection with the calculation of shrinkage effect.⁴ The shrinkage is calculated by taking the difference between the mean value of the internuclear distance in molecule and the sum of the individual bond lengths composing it. In the molecules studied here the shrinkages are calculated and given in Table II. Substitution of deuterium decreases the mean amplitude and shrinkage values.

TABLE I

Generalized mean-square amplitudes of vibration in $\text{CF}_3\text{C} : \text{CH}$ and $\text{CF}_3\text{C} : \text{CD}$ molecules at 300° K (\AA^2)

Distance	Molecule	$\langle (\Delta z)^2 \rangle$	$\langle (\Delta x)^2 \rangle$	$\langle (\Delta y)^2 \rangle$	$\langle \Delta x \Delta z \rangle$	$\langle \Delta x \Delta y \rangle$
C—F	$\text{CF}_3\text{C} : \text{CH}$	0.003885	0.004615	0.001821	-0.002611	..
C—C		0.001274	0.005630	0.005630	..	..
$\text{C} \equiv \text{C}$		0.001015	0.021963	0.021963	..	..
C—H		0.003520	0.057058	0.057058	..	..
F...F		0.005897	0.001615	0.013923	..	-0.000818
F...C ₂		0.004142	0.005188	0.007302	-0.003676	..
F...C ₃		0.009027	0.010106	0.006353	-0.000879	..
F...H		0.035493	0.092586	0.076075	-0.044523	..
C ₁ ...H		0.004389	0.053251	0.053251	..	..
C ₁ ...C ₃		0.002187	0.002115	0.002115	..	..
C ₂ ...H		0.003126	0.046230	0.046230	..	..
C—F	$\text{CF}_3\text{C} : \text{CD}$	0.003885	0.004514	0.000779	-0.003315	..
C—C		0.001274	0.002483	0.002488	..	..
$\text{C} \equiv \text{C}$		0.001015	0.018741	0.018741	..	..
C—D		0.002489	0.042301	0.042301	..	..
F...F		0.006489	0.001987	0.015575	..	-0.000917
F...C ₂		0.004749	0.004757	0.005325	-0.005493	..
F...C ₃		0.009257	0.009478	0.003345	-0.007475	..
F...D		0.030338	0.053023	0.048326	-0.052335	..
C ₁ ...D		0.004329	0.038150	0.038150	..	..
C ₁ ...C ₃		0.002034	0.001840	0.001840	..	..
C ₂ ...D		0.003563	0.032227	0.032227	..	..

TABLE II
Shrinkage effect (\AA) in $\text{CF}_3\text{C} : \text{CH}$ and
 $\text{CF}_3\text{C} : \text{CD}$ at 300° K

Bond	Distance \AA	Shrinkage constant	
		$\text{CF}_3\text{C} : \text{CH}$	$\text{CF}_3\text{C} : \text{CD}$
$\text{C}_1-\text{C}_2 \equiv \text{C}_3$	2.665	0.02072	0.01611
$\text{C}_1-\text{C}_2 \equiv \text{C}_3-\text{H}$ or $\text{C}_1-\text{C}_2 \equiv \text{C}_3-\text{D}$	3.721	0.04522	0.03518
$\text{C}_2 \equiv \text{C}_3-\text{H}$ or $\text{C}_2 \equiv \text{C}_3-\text{D}$	2.257	0.04094	0.03377

Dept. of Phys., K. VENKATESWARLU.
Kerala Univ., MISS MARIAMMA P. MATHEW.
U.C. College,
Alwaye, July 27, 1966.

- Shoolery, J. N., Shulman, R. G., Sheehan, W. F. (Jr.), Schomaker, V. and Vogt, D. M., *J. Chem. Phys.*, 1951, **19**, 1364.
- Meister, A. G., *Ibid.*, 1948, **16**, 950.
- Morino, Y. and Hirota, E., *Ibid.*, 1955, **23**, 737.
- , Nakamura, J. and Moore, P. W., *Ibid.*, 1962, **36**, 1050.

DETERMINATION OF BOND LENGTH IN THIOMALIC ACID COMPLEX OF COBALT (III) FROM X-RAY K-ABSORPTION EDGE FINE STRUCTURE

FOLLOWING the magnetic susceptibility measurements on thiomalic acid (TMA) complex of cobalt (III) carried out by Mathur and Nigam,¹ the present authors² have recently reported the co-ordination number of cobalt and the electronic structure of this complex. The purpose of the note is to give the average bond length from the cobalt ion to its ligands in this complex, for which we have utilised a method based on K-absorption edge fine structure recently described by Levy.³

The experimental set-up for obtaining the absorption spectra and the method of preparing this complex have been described earlier.² The form of the cobalt K absorption edge in the TMA complex is shown in Fig. 1.

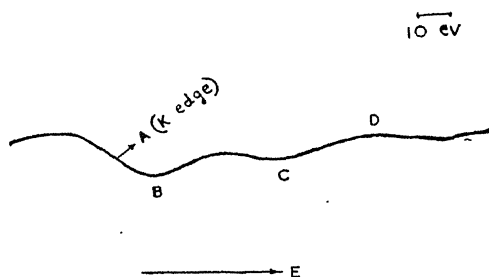


FIG. 1. Shows the form of the Co K absorption edge in the TMA complex of cobalt (III). The curve has been obtained on a Moll Microphotometer with 50 magnification.

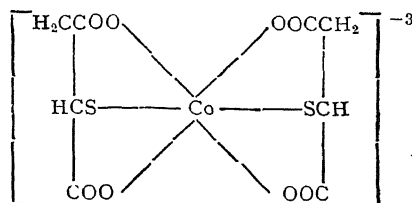
According to Levy *et al.*⁴ the absorption minimum at B (maximum in absorption coefficient curve) corresponds to a transition from the $1s$ to a vacant p level and the minimum at C to a kind of ionisation or "escape" energy for the $1s$ electron. Further, the distance, ΔE , from the minimum at C to the maximum at D gives a measure of the radius of the first co-ordination sphere around the central metal atom through the Bragg relation $r_1 = (151/\Delta E)^{1/2}$. It can thus be supposed that r_1 gives approximately the average bond length from the central atom to its ligands.

In column 2 of Table I are given the bond lengths as determined by the authors by the above method for cobalt metal, CoCO_3 , $\text{CoSO}_4 \cdot 7\text{H}_2\text{O}$ and the TMA complex. In column 3 are given for comparison the values obtained by Levy and Van Wazer⁵ and in column 4 the bond lengths as obtained by X-ray diffraction.

TABLE I
Bond lengths in Angstrom Units

Sample	Authors	Levy and Van Wazer	X-ray Diffraction
Co (Metal)	2.55 ± 0.1	2.57 ± 0.15	2.50
CoCO_3	1.97 ± 0.1	1.98 ± 0.1	1.99
$\text{CoSO}_4 \cdot 7\text{H}_2\text{O}$	1.98 ± 0.1	2.01 ± 0.1	1.99
TMA Complex of CO (III)	2.27 ± 0.1	..	..

It will be seen that the agreement for the first three samples between the values given in columns 2, 3 and 4 in Table I is remarkably good. The structural formula for the TMA complex according to Nigam *et al.*⁶ is as follows:



Our earlier work has shown that 4 oxygen and 2 sulphur atoms surround the central cobalt atom more or less octahedrally in this complex. The bond length 2.27 \AA thus represents the average distance of the cobalt atom from its ligands. It seems quite reasonable to expect this value, which is reported for the first time, to be fairly reliable, on account of the excellent agreement obtained in other compounds between the bond lengths determined by the absorption edge fine structure method and the X-ray diffraction data.

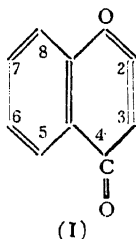
The authors are thankful to Dr. R. M. Levy for sending us some of his results prior to publication and to Dr. L. M. Pant of the National Chemical Laboratory, Poona-8, for helpful discussions. Thanks are also due to the Council of Scientific and Industrial Research, New Delhi, for financing a research scheme which made this work possible.

Department of Physics, CHINTAMANI MANDE,
University of Poona, A. R. CHETAL.
Poona-7, August 4, 1966.

1. Mathur, V. K. and Nigam, H. L., *Naturwissenschaften* 1964, **51**, 35.
2. Mande, C. and Chetal, A. R., *Proc. Ind. Acad. Sci.*, 1965, **62A**, 97.
3. Levy, R. M., *J. Chem. Phys.*, 1965, **43**, 1846.
4. —, Van Wazer, J. R. and Simpson, J., *Inorg. Chem. (Am. Chem. Soc.)*, 1966, **5**, 332.
5. — *ibid.*, —, Private communication.
6. Nigam, H. L., Kapoor, R. C., Kapoor, Uma and Srivastava, S. C., *Ind. J. Chem.*, 1965, **3**, 527.

RESONANCE IN THE PYRONE RING OF CHROMONE

DURING the past few years, NMR has been widely applied for the estimation of aromaticity¹⁻⁶ using the method proposed by Elvidge and Jackman.¹ In this method, the estimate of aromaticity is made from the difference between the chemical shifts of the aromatic protons and similar protons in a model compound which is exactly similar to the aromatic molecule except that it is non-aromatic. In the present communication, this method has been used to detect resonance, if any, in the pyrone ring of chromone (I).



The sample of chromone was obtained commercially and its proton spectrum recorded in a dilute solution in 'analar' carbon tetrachloride on a Varian spectrometer operating at 56.445 Mc./s. is shown in Fig. 1.

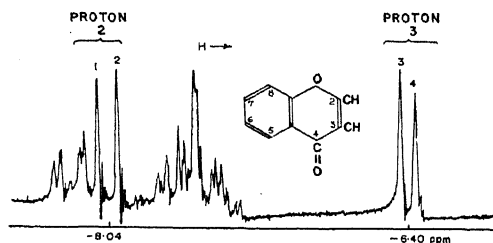


FIG. 1. NMR spectrum of chromone in CCl_4 . Peaks 1, 2 and 3, 4 are due to protons at positions 2 and 3 respectively.

From the intensities of the various lines, it is seen that the lines 1, 2, 3 and 4 are due to protons at positions 2 and 3 and other lines are due to phenyl protons. The first two lines can be assigned to proton at position 2 and the third and fourth lines to that at position 3. This assignment is based on the fact that proton at position (2) is β to carbonyl group and that at position (3) is α to this group. The values of the chemical shifts for the two protons are -8.04 and -6.40 p.p.m. respectively relative to tetramethyl silane.

The proton at position (3) in coumarin is approximately in the same chemical environments as the corresponding proton in chromone. The previously reported work on coumarin²⁻³

indicates that the pyrone ring in this molecule is non-aromatic. Hence, this molecule can be used as a model to find out whether the γ -pyrone ring of chromone is aromatic or not. The chemical shift of proton at position 3 in chromone (-6.40 p.p.m.) is not less than that for proton at position 3 in coumarin (-6.47 p.p.m.). Hence, it can be concluded that the γ -pyrone ring of chromone is also non-aromatic.

It is a great pleasure to thank Dr. C. R. Kanekar for guidance.

Tata Institute of
Fundamental Research,
Bombay-5, August 10, 1966.

G. GOVIL.*
C. L. KHETRAPAL.

* Present address: National Physical Laboratory, Teddington, England.

1. Elvidge, J. A. and Jackman, L. W., *J. Chem. Soc.*, 1961, p. 859.
2. Dharmatti, S. S., Govil, G., Kanekar, C. R., Khetrapal, C. L. and Virmani, Y. P., *Proc. Ind. Acad. Sci.*, 1962, **56**, 71.
3. Khetrapal, C. L., *Ph.D. Thesis*, Bombay University, 1965.
4. De Jongh, H. A. P. and Wynberg, H., *Tetrahedron*, 1965, **21**, 528.
5. Abraham, R. J., Sheppard, R. C., Thomas, W. A. and Turner, S., *Chem. Comm. No. 3*, 1965, p. 43.
6. Elvidge, J. A., *Ibid.*, 1965, p. 160.

CRYSTALLINE CHEMICAL COMPONENTS OF THE LEAVES OF RHODODENDRON VEITCHIANUM HOOK.

PLANTS belonging to the genus *Rhododendron* are considered to be cattle poisons. *R. veitchianum* has not been chemically examined so far. The leaves of this plant used in the present study were obtained from the Nilgiri Hills region in South India. The powdered dry leaves were extracted with petroleum ether, chloroform and alcohol in succession.

The petroleum ether extract on concentration yielded a crystalline solid marked substance A. The residue obtained from the mother liquors was saponified with potash in benzene-alcohol, solvents were removed by distillation after addition of water and the neutral substances extracted with petroleum ether. Removal of the solvent and crystallisation from benzene-petroleum ether yielded substance B.

Substance A.—Thin rectangular rods from chloroform, m.p. $224-26^\circ$. Homogeneous according to TLC on silica gel and column chromatography on alumina. $[\alpha]_D^{27} + 100^\circ$ (chloroform). Formula $\text{C}_{30}\text{H}_{50}\text{O}_2$. Colour in Liebermann-Burchard reaction: pink-red-purple-violet. No reaction with DNP reagent and with mineral

acids in alcoholic solution. Acetate (pyridine-acetic anhydride at room temperature or sodium acetate-acetic anhydride at 130–40°): Colourless thick plates from methanol, m.p. 128–30°, $[\alpha]_D^{25} + 64^\circ$ (methanol). Homogeneous according to TLC on silica gel and column chromatography on alumina. Formula $C_{34}H_{54}O_4$, H_2O .

Substance B.—Colourless thin irregular plates, m.p. 210–12°, homogeneous according to TLC on silica gel and column chromatography on alumina. $[\alpha]_D^{25} + 67^\circ$ (chloroform). Colour in Liebermann-Burchard reaction: pink-orange-purple-bluish violet. Formula $C_{30}H_{50}O$. Treatment with mineral acid in alcohol brought about no change. Acetate (hot acetic anhydride-sodium acetate) $C_{32}H_{52}O_2$: Colourless thick plates from petroleum ether, m.p. 212–14°, $[\alpha]_D^{25} + 62^\circ$ (chloroform); chromatographically homogeneous. Mixed m.p. with parent substance depressed. Benzoate (pyridine-benzoyl chloride at 130–40°); slender rods from petroleum ether; $C_{37}H_{54}O_2$, H_2O , m.p. 192–94°; $[\alpha]_D^{25} + 72^\circ$ (chloroform), chromatographically homogeneous.

Substances A and B seem to be new triterpenoids and work on their chemistry is in progress.

The chloroform extract of the leaves was evaporated and the residue divided into acetone-solubles and acetone-insolubles. The former yielded a minor component as colourless needles from rectified spirit, m.p. 264–66°, giving a red colour in the Liebermann-Burchard test. The acetone-insoluble portion was taken in benzene-alcohol 1:1, diluted with an equal volume of water and the layers separated. The aqueous alcoholic layer containing a lot of finely divided matter was extracted with ether and the ether extract added to the benzene solution. The benzene-ether solution was shaken with 5% aqueous sodium hydroxide. Three zones separated on standing. The lower alkaline zone on working up after acidifying yielded nothing worthwhile. The middle zone containing insoluble sodium salt of organic acid was filtered and decomposed with mineral acid in hot alcoholic medium and the precipitated acid filtered and washed. Crystallisation from alcohol yielded short stout rods $C_{30}H_{48}O_3$, m.p. 280–82°, $[\alpha]_D^{25} + 60^\circ$ (pyridine). Acetate (hot sodium acetate-acetic anhydride): rectangular rods, m.p. 293–95°; $[\alpha]_D^{25} + 69^\circ$ (chloroform), $C_{32}H_{50}O_4$. These two substances were identical with authentic ursolic acid and its acetate according to colour reactions, m.p., mixed m.p. and comparative chromatography on silica gel TLC plate.

The upper organic solvent zone on concentration yielded a pale yellow solid, which was insoluble in all common organic solvents except glacial acetic acid. Addition of about 5% water to the glacial acetic acid solution resulted in the rapid separation of a pale buff-coloured powder, which melted at 200–04° and gave the following colours in the Liebermann-Burchard reaction: pink-reddish violet-violet. This is also evidently a new triterpenoid and its closer study is under way.

The alcoholic extract of the leaves was concentrated to low bulk. The solid that separated during this operation was filtered and crystallised from alcohol; it was found to be ursolic acid (already described under the chloroform extract). The clear alcoholic mother liquor was diluted with water, alcohol removed as far as possible by distillation and the largely aqueous residue extracted with ether. The ether extract was shaken with 5% aqueous potash and the alkaline solution acidified. After rejecting resins that separated at this stage, the supernatant solution was extracted with ether. Removal of solvent yielded a yellow solid which crystallised from alcohol as rods and needles, m.p. 305–08°. It gave all colour reactions of flavonols and yielded an acetate (hot acetic anhydride-sodium acetate), colourless needles, m.p. 192–94°. Mixed m.p.s. of these two substances with authentic quercetin and quercetin penta-acetate respectively were undepressed. The identity was confirmed by comparing the substance of m.p. 305–08° with authentic quercetin by paper chromatography.

The aqueous residue of the alcoholic extract which had been ether-extracted as mentioned before was hydrolysed by boiling for 2 hr. with sulphuric acid (effective concentration 7%). The bulky brown precipitate that separated on cooling was rejected and the clear supernatant liquid extracted with ether. Evaporation of the ether yielded more quercetin (colour reactions, m.p. and m.m.p.).

To sum up, the leaves of *Rhododendron veitchianum* contain three new triterpenoids besides ursolic acid. Quercetin is present both free and in combination.

The authors thank Professor T. R. Seshadri for his interest.

Chemistry Dept., S. RANGASWAMI.
Delhi Univ. Delhi,
Pharmacy Dept., G. S. R. C. V. PRASADA RAO.
Andhra University,
Waltair, July 19, 1966.

THERMAL DECOMPOSITION OF ALUMINIUM ALKOXIDES

IN considering the mechanism of the catalytic decomposition of alcohols over alumina, surface aluminium alkoxides have been proposed as intermediates.¹ Hence the thermal decomposition of aluminium alkoxides was studied in order to compare the product distribution of this reaction with that of the catalytic decomposition of the corresponding parent alcohols over alumina. A similar study with alcohols that do not contain β -hydrogen atoms has been reported recently.² Typical results of the decomposition of aluminium 2-butoxide and aluminium 2-pentoxide are given in Tables I and II respectively and are compared with the

olefins and no ethers or carbonyl compounds were detected. Examination of the results in the tables shows that the pyrolytic reaction and the catalytic reaction yield the same products but in different ratios, thus suggesting that the mechanisms of the two reactions are different. Catalytic dehydration of alcohols over alumina has been shown to proceed by a *trans* elimination mechanism.⁵ The stereochemistry of the pyrolytic reaction is at present being investigated by us.

Department of Chemistry,
Indian Inst. of Technology,
Madras-36, June 9, 1966.

K. NARAYANAN,
C. N. PILLAI,
ELLEN HAUG.

TABLE I
Dehydration of 2-butanol

Sl. No.	Reaction	Per cent. composition of butenes			<i>cis/trans</i> ratio
		1-butene	<i>cis</i> -2-butene	<i>trans</i> -2-butene	
1	Pyrolysis of aluminium 2-butoxide at 324°C.:				
	Fraction I ..	40	30	30	1.00
	" II ..	41	30	29	1.04
	" III ..	34	31	35	0.89
2	Dehydration of 2-butanol over alumina at 273°C.*	43.5	48.1	8.4	5.73
3	Thermodynamic equilibrium at 327°C.**	21.16	29.12	49.72	0.59

* From reference 3;

** From reference 4.

TABLE II
Dehydration of 2-pentanol

Sl. No.	Reaction	Per cent. composition of pentenes			<i>cis/trans</i> ratio
		1-pentene	<i>cis</i> -2-pentene	<i>trans</i> -2-pentene	
1	Pyrolysis of aluminium 2-pentoxide at 324°C.:				
	Fraction I ..	39	28.5	32.5	0.88
	" II ..	41	28	31	0.90
	" III ..	33	30	37	0.81
2	Dehydration of 2-pentanol over alumina at 273°C.*	41	47	12	3.9
3	Thermodynamic equilibrium at 327°C.**	13.3	33.3	53.3	0.62

* From reference 3;

** From reference 4.

product distribution of the dehydration of 2-butanol and 2-pentanol over alumina under mild conditions.

The pyrolytic reactions were carried out in a distilling flask with stirring, the products being collected in suitable receivers and analyzed by gas chromatography. By collecting several fractions and analyzing, it was ensured that the products formed in the early stages of the reaction are true primary reaction products. (In the tables, see that fractions I and II have the same composition.) Only expected

1. Topcheiva, K. V., Yun-Pin, K. and Smirnova, I. V., In *Advances in Catalysis*, Academic Press, Inc., New York, 1957, 9, 799.
2. Heiba, E. I. and Landis, P. S., *J. Catalysis*, 1964, 3, 471.
3. Pillai, C. N. and Pines, H., *J. Am. Chem. Soc.*, 1961, 83, 3270.
4. Kilpatrick, J. E., Prosen, E. J., Pitzer, K. S. and Rossini, F. D., *J. Res. Natl. Bur. Standards*, 1946, 36, 559.
5. Pines, H. and Pillai, C. N. *J. Am. Chem. Soc.*, 1961, 83, 3270.

NATURE OF HYDROGEN
CHEMISORPTION ON SUPPORTED
IRON POWDER

REFINED experimental techniques employed with surfaces of evaporated metal films and filaments have proved the occurrence of multiple chemisorption states as a common feature of hydrogen adsorption on metals.¹ This paper presents some results which throw light on the nature of hydrogen chemisorption on metal powders in general.

The catalyst employed was a sample of iron-kieselguhr (5.47 gm.) prepared by the method of impregnation, thoroughly reduced in a current of pure hydrogen at 450° C. Adsorption measurements were made on a conventional apparatus.² After determination of an adsorption isotherm at a given temperature, the sample was maintained at the same temperature, and the Töpler pump operated. The gas in the system and the gas desorbed from the powder was collected and measured. From the difference, the amount of gas retained by the catalyst was determined. After desorption of the gas, a readsorption isotherm of hydrogen was again determined on the same sample still maintaining it at the original temperature of adsorption.

The following observations can be made from the data presented in Table I. (1) At any

been suggested that the amount of gas chemisorbed instantaneously when the adsorbate is brought into contact with the evacuated adsorbent is an indication of the purity of the surface. Generally the chemisorption at the end of one minute after the admission of the gas is designated as instantaneous or fast chemisorption. The results presented in Table I reveal that the fast chemisorption is also a function of temperature, increasing with increase in temperature. Further the volume of gas taken up during fast chemisorption expressed as a percentage of retention volume also increases with temperature from 97° C. to 300° C. At lower temperatures even the more active sites take some time in getting occupied by the adsorbate. At temperatures of 350° C. and above, it is possible that the fast chemisorption is completed in a very short time (less than one minute) as the retention volumes are less than the fast chemisorption volumes.

The above observations lead to the tentative conclusion that the hydrogen molecules taken up during instantaneous or fast chemisorption undergo dissociation into atoms because of the high initial heats of chemisorption and these adsorbed species are retained during desorption by the Töpler pump. The adsorbed species involved in weak chemisorption, which can be desorbed at the temperature of adsorption,

TABLE I
(Volumes of gas always expressed in c.c. N.T.P.)

	97° C.	134° C.	200° C.	250° C.	300° C.	350° C.
1. Adsorption of H ₂ at 680 mm. Hg	.. 1.66	2.11	2.60	3.15	3.39	4.04
2. Retention	.. 1.05	1.17	1.57	1.97	2.01	2.20
3. Readsorption at 680 mm. Hg	.. 0.93	1.05	1.22	1.56	1.80	1.96
4. Retention <i>plus</i> readsorption	.. 1.98	2.22	2.79	3.53	3.81	4.16
5. Adsorption after 1 minute at 680 mm. Hg	.. 0.33	0.68	1.36	1.66	1.92	2.26
6. Percentage of adsorption at 1 minute as a function of retention	.. 31.4	58.1	86.6	84.3	95.5	>100

temperature, a part of the gas, taken up by the adsorbent, can be desorbed by means of a Töpler pump at the same temperature. This shows that the molecules in the desorbed gas were held to the surface by weak chemisorption forces. (2) At all the temperatures studied, the percentage of gas retained out of the total adsorption is around 55 to 65%. (3) The sum of retention and readsorption volumes at 680 mm. Hg, exceed the original adsorption volume at the same pressure. It is possible that during the desorption process, there is a creation of active sites because of migration of the adsorbed molecules, in the volume of gas retained, from accessible to inaccessible sites on the surface. (4) It has

probably involves hydrogen molecules as suggested by Kavatardze.³

The author expresses his gratitude to Prof. M. R. A. Rao, Department of Inorganic and Physical Chemistry, Indian Institute of Science, Bangalore, for his guidance during the course of this work.

Department of Chemistry, C. S. SWAMY.
Indian Institute of Technology,
Madras-36, June 6, 1966.

1. Sachtler and Dorgelo, *Bull. Soc. Chim. Belges*, 1958, **67**, 465.
2. Srinivasan, V., *Proc. Ind. Acad. Sci.*, 1957, **46 A**, 120.
3. Kavatardze, *Shur. Fiz. Khim.*, 1958, **32**, 909, 1055, 1214.

RARE EARTH NITRATE COMPLEXES OF DIMETHYL SULPHOXIDE

IN continuation of the work on rare earth chloride complexes of dimethyl sulphoxide¹ (DMSO), we report here the isolation and characterization of seven new complexes of rare earth nitrates with DMSO, of the general formula $M(DMSO)_n(NO_3)_3$ where $M = La, Ce, Pr, Nd, Sm$ or Gd ; $n = 4$ and $M = Y$; $n = 3$. The complexes precipitated on mixing a slight excess of DMSO with a methanolic solution of hydrated rare earth nitrates. The precipitate was filtered off, washed with dry benzene and recrystallised from methanol.

The complexes are soluble in acetone, acetonitrile, DMSO and dimethyl formamide (DMF) and are insoluble in benzene and nitrobenzene. The colours are quite similar to those of parent nitrates. The physical properties along with principal infra-red and conductivity data for typical cases are presented in Table I.

ordination number of at least 7 for rare earths and 6 for Yttrium. In DMF, however, they behave as 1:2 electrolytes, showing that the two replaceable nitrate groups are probably bound differently from the third. DMF being a monodentate ligand, it is probable that the two replaceable nitrate groups are monodentate while the third is bidentate. The co-ordination number then becomes 8 for lanthanons and 7 for Yttrium. These co-ordination numbers for rare earths^{4,5} and the dual behaviour of nitrate group in complexes⁶ are not uncommon. The complexes, on the other hand, show a 1:3 electrolytic structure in DMSO, indicating complete dissociation.

Our thanks are due to Prof. M. R. A. Rao for his keen interest in the work.

Dept. of Inorganic and S. K. RAMALINGAM.
Physical Chemistry, S. SOUNDARARAJAN.
Indian Institute of Science,
Bangalore-12 (India), June 25, 1966.

TABLE I
Principal infra-red and conductivity data for typical complexes

Compound	Colour	Melting point (° C.)	S=O stretch cm. ⁻¹	C—S stretch cm. ⁻¹	C _{2v} nitrate			Asymmetry stretch cm. ⁻¹	Molar conductivity (Λ m) in Ω^{-1} cm. ² mole ⁻¹
					N—O stretch cm. ⁻¹	NO ₂ symmetry stretch cm. ⁻¹			
DMSO	..	Colourless	18.5	1043 s, b	698 m	..	..	..	..
La(DMSO) ₄ (NO ₃) ₃	..	White	118	1010 s	718 m	1034 s	1298 s	1460 s, b	22.5 143.0
Y(DMSO) ₃ (NO ₃) ₃	..	do.	155	1011 s	718 m	1034 s	1298 s	1468 s, b	7.99 144.4

Note: Molar conductance for 1:1 electrolytes in acetonitrile lies around 190 and in DMF around 85 Ω^{-1} cm.² mole⁻¹. Λ m for 1:2 electrolytes in DMF lies in the range 140–170 m=medium; s=strong; s, b=strong, broad.

Analyses of the metal, nitrate and DMSO parts of the complexes conform to the formulæ mentioned. All the complexes yield similar infra-red spectra showing no dependence on the particular metal ion or the number of DMSO molecules co-ordinated to it. The observed decrease in the stretching frequency of the S=O bond reveals co-ordination through oxygen.² Accordingly there is an enhancement in the C—S stretching frequency too. While the bands at 1298 (s), 1034 (s) and 1460 (s) cm.⁻¹ suggest³ the presence of covalent nitrate (C_{2v} symmetry), the absence of a band around 1380 cm.⁻¹ (in hexachlorobutadiene mull spectrum) clearly excludes any ionic nitrate in the complex. This is further confirmed by conductivity data.

The complexes behave as non-electrolytes in acetone and acetonitrile, suggesting a co-

1. Ramalingam, S. K. and Soundararajan, S., *Curr. Sci. (India)*, 1966, **35** (9), 233.
2. Cotton, F. A. and Francis, R., *J. Amer. Chem. Soc.*, 1960, **82**, 2986.
3. Gatehouse, B. M., Livingstone, S. E. and Nyholm, R. S., *J. Chem. Soc.*, 1957, pp. 4222.
4. Bauer, H., Blanc, J. and Ross, D. L., *J. Amer. Chem. Soc.*, 1964, **86**, 5118.
5. Moeller, T., et al., *Chem. Reviews*, 1965, **65**, 1.
6. Curtis, N. F. and Curtis, Y. M., *Inorg. Chem.*, 1965, **4** (6), 804.

COMPLEXOMETRIC ESTIMATION OF PHOSPHATE

DEVELOPMENT of simple analytical method of estimation of phosphate has been the subject of recent interest.¹⁻⁴ We developed a simple titrimetric method using ethylene diamine-tetraacetic acid (EDTA).

The principle of this method is that in excess of bismuth solution, phosphate gets precipitated

at pH 0.5–2.0, quantitatively; and the remaining bismuth can be titrated by EDTA even in presence of the precipitate. For estimation of Bi^{3+} by EDTA thiourea has been suggested as indicator,⁵ the colour change being from yellow to white. This was however found to be unsatisfactory especially in presence of sugar solutions.⁶ We employed the violet colour of iron-salicylate complex⁷ as indicator for estimation of excess of Bi^{3+} . In a mixture of Bi^{3+} and Fe^{3+} EDTA reacts first with Bi^{3+} and then with Fe^{3+} especially at pH 0.5.⁸ During titration against EDTA, the disappearance of violet colour indicates the completion of the chelation of both Bi^{3+} and Fe^{3+} by EDTA.

The following stock solutions were used:

(A) $\text{Bi}(\text{NO}_3)_3$	.. 0.05 M.
(B) $\text{Fe}(\text{NO}_3)_3$	.. 0.0325 M.
(C) $(\text{NH}_4)_2\text{HPO}_4$	.. 0.05 M.
(D) Disodium salt of EDTA	.. 0.05 M.

Of these, A, C and D were of Merck Analar grade, while B was of Riedel Laboratory grade. The solutions of A and B were made in Analar nitric acid solution. Salicylic acid was of practical grade; this was recrystallised and used.

The procedure employed was as follows: An aliquot of A was taken into a conical flask to which 2.0 ml. of B was added. The pH of the solution was adjusted to 0.5 by addition of adequate quantity of HNO_3 . To this was added ethanol (ca. 10%) and a known volume of C. The contents of the flask were shaken well and heated to 50°–60° C. 0.1 gm. of salicylic acid was added when intense violet colour developed. The system was titrated against EDTA till the violet colour disappeared.

Table I gives a typical set of results obtained. In column 2 is reported the amount of

TABLE I

Estimation of phosphate by complexometric titration

Bi^{3+} solution taken = 5 ml.; Fe^{3+} solution taken = 10 ml.

PO_4^{3-} taken (mM) (1)	PO_4^{3-} found (mM) (2)	Error (3)
0.0400	0.0395	(1.25%)
0.0500	0.0500	0
0.0600	0.0600	0
0.0800	0.0800	0
0.1000	0.1000	0
0.1200	0.1200	0
0.2000	0.1990	0.5
0.1600	0.1590	0.6
0.3000	0.2980	0.6

phosphate calculated from the titre value which gave an estimate of Fe^{3+} and unused

Bi^{3+} . It is seen that the error of estimation of PO_4^{3-} in our method is of the order of 0.6%.

Thanks are due to Prof. N. A. Ramaiah, National Sugar Institute, Kanpur, for suggesting the problem and guidance and to Dr. T. S. Srivastava and Dr. S. S. Katyar for their help during the investigation.

Department of Chemistry,
V.S.S.D. College, Kanpur,
May 31, 1966.

G. D. TIWARI.

S. R. TRIVEDI.

1. Bennewitz and Tacner, *Mikro Chim. Acta*, 1959, p. 835.
2. Buss, Kohlschuelter and Preiss, *Z. Anal. Chem.*, 1963, **193**, 264.
3. Taulli and Irani, *Anal. Chem.*, 1963, **35**, 1060.
4. Bakacs, *Z. Anal. Chem.*, 1962, **190**, 373.
5. Fritz, *Anal. Chem.*, 1954, **26**, 1978.
6. Ramaiah and Katyar, Unpublished results.
7. Babko, *Zavodskaya Lab.*, 1947, **13**, 645.
8. Katyar, Tiwari and Trivedi, Communicated (*Ind. Chem. Soc.*).

A PETRIFIED BENNETTITALEAN FLOWER FROM THE RAJMAHAL HILLS, INDIA

From Amarjola near Amrapara, Rajmahal Hills, Bihar, a large number of petrified Bennettitalean flowers were collected during the years 1950–65. Out of these, except one, all were found to be the female flowers of *Williamsonia* Carruthers. The remaining one, when longitudinally cut into two halves, was found to belong to the genus *Cycadeoidea* Buckland. This flower is here described as a new species, viz., *C. dactylota* (Fig. 1).

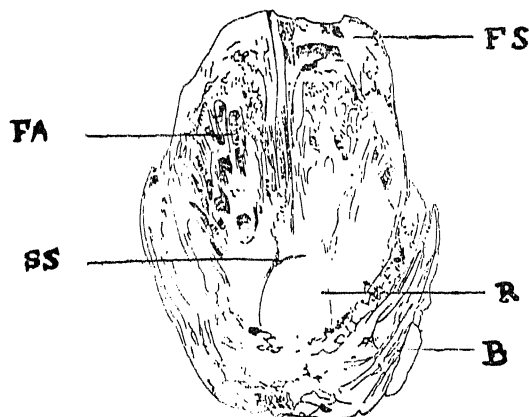


FIG. 1. *Cycadeoidea dactylota* n. sp.
B.S.I.P. No. 24133, ca., x 1.

The flower is bisexual consisting of an axis bearing sterile bracts (B), androecium (FS) and the female receptacle (R) with semiferous and interseminal scales (SS). Flower

as a whole is oval, measuring about 6 cm. in length and 4.5 cm. in breadth at its broadest region. Bracts, forming a perianth, are in more than two turns. All of them are incomplete and have prominent hairs.

Andrœcium is ovate, near the apex slightly incomplete, entirely covering and concealing the female receptacle, on the external surface showing 12 prominent ridges and grooves. Andrœcium is supposed to be made up of 12 fused 'microsporophylls' and has the same parenchymatous dome as found in some of the American Cycadeoideas described by Delevoryas.¹ The inner wall of the fused 'microsporophylls' has a large number of projecting finger-like appendages (FA). Each appendage in median longitudinal section shows two series of small chambers along the entire length. Each chamber is full of oval pollen grains about $16-24 \times 24-36 \mu$ in size. Unlike the American Cycadeoideas, the pollen-bearing appendages of *C. dactylota* are more like the 'finger-like appendages' of *Williamsonia santalensis* Sitholey and Bose.²

Female receptacle is dome-shaped and the seminiferous and the interseminal scales are visible only at places. They are in very young stages of development, showing only a few cells here and there.

I am grateful to Dr. R. N. Lakhanpal for kindly going through the manuscript.

Birbal Sahni Institute of M. N. Bose,
Palaeobotany,
Lucknow, March 26, 1966.

1. Delevoryas, T., *Amer. Jour. Bot.*, 1963, 50 (1).

2. Sitholey, R. V. and Bose, M. N., *Palaeobotanist*, 1953, 2.

UNILATERALLY ACTIVE TESTIS IN SOME INDIAN BIRDS*

In birds testicular asymmetry is very common. Test¹ has shown in the American woodpeckers that the left testis is always longer and more slender than the right. The avian testis is generally ovoid in its shape and the volume varies with the season and sexual activity. Whatever the size variation may be, the spermatogenetic activity is not impaired in the smaller testis. While the left testis is usually longer in size, Owen² recorded that in one instance of a rook the right had overgrown, compensating for the small size of the left testis.

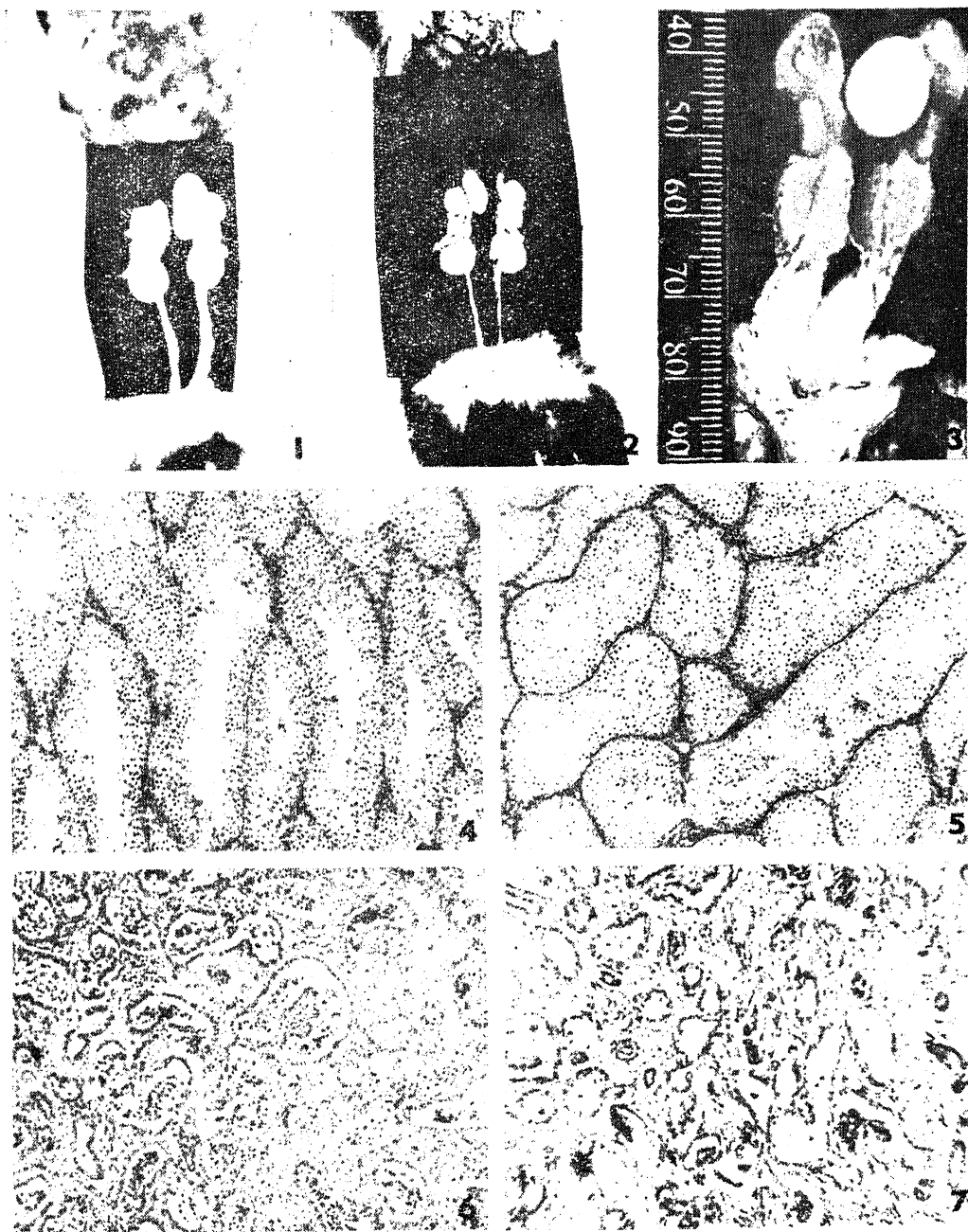
During the reproductive season, the growth of the testis from the regressed condition is phenomenal. Roberts³ records that in the

Gentoo penguin at South Georgia, the testes reach ten times their original volume by mid-October. While there is thus a reference to difference in size, so far as I am aware, there is no record of unilaterally active testis in birds. During the studies of the reproductive physiology of desert birds, I came across such physiological unilaterally active testis in the pigeon [*Columba livia* (Gmelin)] and in the common house crow (*Corvus splendens* Vieillot).

In the pigeon, while the left testis is longer than the right normally, either the right or left testis may become nonfunctional and degenerate (Figs. 1, 2). The size difference between the functional and nonfunctional testis is considerable. Having examined more than 350 male pigeons, I have come across only two instances of this abnormality. In the crow of which more than 225 males have been examined, I came across three instances where in two the right testis was nonfunctional and degenerate and there was compensatory hypertrophy of the left one, whereas in the third specimen the left testis was nonfunctional and there was compensatory hypotrophy of the right one. I have appended a table of the size measurements of the testis in the sexually active normal and abnormal pigeon and crow.

The comparative data of the normal sexually active pigeon and the sexually inactive crow are from the males procured on the day this abnormality was met with and therefore, they serve as controls. As could be seen, the pigeons were sexually active and the crows were not. A peculiarity to be noted is that in the unilaterally active crow, the left hypertrophied testis showed spermatogenetic activity even though the normal crows showed regressed testes. These abnormal animals, therefore, appear not to be governed by the same environmental conditions that control the normals.

The histology of the unilaterally inactive testis is revealing. While the companion testis shows spermatogenetic activity (Figs. 4, 5), the undeveloped ones both in the case of the pigeon and crow show an increase in thickness of the tunica albuginea resembling that of the regressed testes; there is a massive increase in the intertubular tissue (Figs. 6-9); the connective tissue cells and Leydig cells have increased. In the tubules the seminal epithelium is of uniform size and occasionally, there is noticed a large cell, may be the spermatogonium. No indication of the Sertoli cells is seen. The lumen is filled with cellular debris sloughed off from the epithelium, in some cells of which, mitotic figures may be seen. No sperms are seen in the testis.



FIGS. 1-7. Fig. 1. Reproductive tract of pigeon showing the right testis unilaterally inactive (on black background), $\times 1/4$. Fig. 2. Reproductive tract of male pigeon showing the left testis unilaterally inactive (on black background), $\times 1/5$. Fig. 3. Reproductive tract of male crow showing the right testis unilaterally inactive (on black background). Fig. 4. Photomicrograph of the functional left testis of the unilaterally sexually active pigeon, $\times 100$. Fig. 5. Photomicrograph of the functional left testis of the unilaterally sexually active crow, $\times 100$. Fig. 6. Photomicrograph of the nonfunctional right testis of unilaterally active pigeon, $\times 100$. Fig. 7. Photomicrograph of the nonfunctional right testis of unilaterally sexually active crow, $\times 100$.

TABLE I
Showing the size differences in testes of the abnormal Pigeon and Crow

	Bird weight (in gm.)	Left testis		Weight (in gm.)	Right testis		Weight (in gm.)
		Length (in mm.)	Breadth (in mm.)		Length (in mm.)	Breadth (in mm.)	
Pigeon 12/14 January 1963	Sexually active						
	263	19	11	0.637	13	8	0.552
	280	21	9	0.713	17	9	0.590
Asymet. l.t. Testis	262	3	2	0.011	21	9	0.658
Asymet. Rt. Testis	296	22	10	0.632	4	2	0.013
Crow 30 April 1964	Sexually inactive						
	295	8	4	0.432	5	4	0.326
	298	9	4	0.437	6	4	0.329
Asymet.	285	17	9	0.521	1	1	0.011
Right Testis	293	13	10	0.607	1	1	0.013
Crow 13 November 1965	Sexually inactive						
	289.5	5	4	0.027	5	3	0.026
	288.0	5	4	0.026	5	3	0.024
Asymet. Lt. Testis	284.5**	3	1	..	22	12	..

** Tract taken for photography.

In the contralateral testis of the pigeon, active divisions are noticed and sperm are present in all the tubules while in the crow, the testis shows sperm peripherally, the central tubules showing only the stages of division.

The unilaterally active testis described here for the birds is not very different from that described as cryptorchism in the rat by Kennedy.⁴

Department of Zoology, D. K. Vyas.
Reproduction Physiology Section,
University of Rajasthan,
Jaipur (India), May 3, 1966.

* Investigation made possible from a grant from the Ford Foundation, New Delhi.

1. Test, F. H., *Pap. Mich. Acad. Sci.*, 1944, **30**, 347.
2. Owen, R., *On the Anatomy of Vertebrates* (Birds & Mammals) (Longmans, Green & Co., London, 1866), Vol. 2.
3. Roberts, B., *British Graham Land Expedition*, 1934-37; *Sci. Repts.*, 1940, **1**, 195.
4. Kennedy, W. P., *J. Anat.*, 1927, **3**, 352.

INFLUENCE OF LEAFHOPPER INFESTATION ON THE PIGMENT CONTENTS OF CASTOR VARIETIES IN RELATION TO THEIR RESISTANCE TO *EMPOASCA FLAVESCENS* (F.) (HOMOPTERA, JASSIDAE)

MANY species of *Empoasca* have been reported to cause typical phytotoxemia injuries called "hopperburn". The effect of such an injury on the physiology of the plant, with particular reference to the plant resistance to insects, has not been studied adequately. In the present observations, castor varieties (*Ricinus com-*

munis L.) representing susceptible, tolerant and resistant categories to the infestation of the leafhopper, *Empoasca flavescens* (F.),¹ were used to study the effect of injury on three important pigments of plants, namely, chlorophyll, carotene and xanthophyll.

The varieties Dominica (susceptible), C 3 Pakistan and R.C. 1098 Baker were used and the leafhoppers introduced into caged leaves of same age in potted plants. The study was undertaken under insectary conditions with temperature ranging from 21 to 24° C and humidity at 80% maintained by evaporative air-coolers. The diffused natural light inside the insectary was supplemented by providing a number of fluorescent lamps of intensity up to 160 W for 10-12 hours a day. The chlorophyll contents of healthy and infested leaves were extracted according to the official methods of A.O.A.C.² and estimated colorimetrically by comparing with an artificial standard solution of Guthrie.³ In the determination of the carotene and xanthophyll contents, the method of Snell and Snell⁴ was followed using potassium dichromate (0.2%) as the standard. The intensity of the colours were read in a Klett-Summerson Photoelectric colorimeter using a red filter (660 mμ).

The results presented in Table I show that the leafhopper attack resulted in the depletion of chlorophyll content by 23.3% in the susceptible variety and only to the extent of 2.1% and 1.8% respectively in the tolerant and resistant varieties. While all the three varieties had similar chlorophyll content in the healthy uninfested stage, the jassid infestation reduced the content markedly in the Dominica variety

alone. The healthy plants of susceptible and tolerant varieties had respectively 23% and 14% more carotene than the resistant variety even though the differences in this regard were not statistically significant. Jassid feeding also did not influence the quantity. However, the xanthophyll contents were significantly greater by over 64% in the tolerant and susceptible plants and there was no effect of jassid incidence in its content.

TABLE I

Effect of leafhopper infestation on the pigment contents of castor varieties

Variety	Chlorophyll mg./g.	Carotene µg./g.	Xanthophyll parts/g.
1. Dominica (Susceptible):			
Healthy	.. 3.79	5.76	525.13
Infested	.. 2.91	5.82	533.13
2. C3 Pakistan (Tolerant):			
Healthy	.. 3.70	5.34	534.83
Infested	.. 3.63	5.41	548.59
3. R.C. 1098 Baker (Resistant):			
Healthy	.. 3.64	4.70	321.18
Infested	.. 3.57	4.72	323.53
Critical difference ($P=0.05$)	.. 0.16	n.s.	115.52

A consideration of the effect of jassid infestation on the chlorophyll in different varieties seems to be important for the better understanding of carbohydrate metabolism of castor varieties. There has been a reduction in the chlorophyll content of infested Dominica variety up to 23.3% whereas this reduction is almost negligible in the other two varieties. The retardation in the synthesis of carbohydrates owing to low chlorophyll content is of particular interest.⁵ As the chlorophyll content is reduced a corresponding decrease in moisture is also noticed.⁶ The efficiency of photosynthesis in the plants is affected when the affinity of chlorophyll for water is interfered with as observed by Gaffron.⁷ According to Griffiths *et al.*⁸ and Cohen-Bazire *et al.*,⁹ carotenoids serve in the protection of chlorophyll mechanisms against free oxygen and in this context, the increase of carotene and xanthophyll contents in the infested plants of the susceptible variety probably assumes significance.

The concentration of carotene and xanthophyll in susceptible and tolerant varieties showed a higher trend than in the resistant variety. This fact is presumed to be related, at least in part, with the non-preference mechanism of resistance involved. Carotene is a precursor of vitamin A, and animals seem

capable of forming the vitamin from this pigment.¹⁰ Fraenkel¹¹ considered carotenes of plants as nutritionally important because of their conversion to cuticular pigments in certain phytophagous insects. A retarded growth and high mortality of *Schistocerca gregaria* Forskal was noticed when fed with diet deficient in B-carotene.¹² Murthy¹³ observed beneficial effects of carotene added to mulberry leaf powder in the development of *Bombyx mori* L. However, Ham and Tysdal¹⁴ observed less visible leafhopper injury in alfalfa strains and hybrids rich in carotene. Quantitative difference in carotene was also noticed in corn lines differing in resistance to the corn leaf aphid.¹⁵

The work formed part of the Doctoral Thesis submitted by the senior author to the University of Madras and financial assistance was made by the Council of Scientific and Industrial Research, New Delhi. Grateful appreciation is extended to Prof. R. H. Painter, Kansas State University, Kansas, U.S.A., for evincing keen interest in the study.

Faculty of Entomology, S. JAYARAJ.
Agricultural College and A. R. SESHADRI.
Research Institute,
Coimbatore, May 6, 1966.

- Jayaraj, S., *Z. angew. Ent.*, 1966 a, 57 (in press).
- A.O.A.C., *Official Methods of Analysis of the Association of Official Agricultural Chemists* (Ed. W. Horwitz), A.O.A.C. Publication, Washington, D.C., 1960, p. 832.
- Guthrie, J. D., *Amer. J. Bot.*, 1928, 15, 86.
- Snell, F. D. and Snell, C. T., *Colorimetric Methods of Analysis*, Chapman and Hall Ltd., London, 1937, 2, 682.
- Jayaraj, S., *Indian J. Exptl. Biol.*, 1966 b (in press).
- , *Phytopath. Z.*, 1966 c, 57, 121.
- Gaffron, H., *Plant Physiology—A Treatise*, 1960, 1 B, 3.
- Griffiths, M., Sistrom, W. R., Cohen-Bazire, G., Stainer, R. Y. and Calvin, M., *Nature, Lond.*, 1955, 176, 1211.
- Cohen-Bazire, G., Sistrom, W. R. and Stainer, R. Y., *J. Cell. Comp. Physiol.*, 1957, 49, 25.
- Curtis, O. F. and Clark, D. G., *An Introduction to Plant Physiology*, McGraw-Hill Book Co., Inc., New York, 1950.
- Fraenkel, G., *Trans. 9th Int. Cong. Ent. Amsterdam*, 1953, 2, 90.
- Dadd, R. H., *Nature, Lond.*, 1957, 179, 427.
- Murthy, M. R. V., Unpublished Doctoral Thesis, Univ. of Mysore, 1953.
- Ham, W. E. and Tysdal, H. M., *J. Amer. Soc. Agron.*, 1946, 38, 68.
- Coon, B. F., Miller, R. C. and Aurand, L. W., *Penn. Agr. Expt. Sta. Dept. Zoo. and Ent. Multilith Rpt.*, 1948, p. 8.

**IN VITRO PRODUCTION OF PETALS
FROM ANTHERS OF
ALTHEA ROSEA (HOLLYHOCK)**

DESPITE a great surge of interest in the problems relating to the nature of modification that the floral parts undergo during 'doubling' the causes responsible for inducing such change in the developmental pattern of double flowers and mechanism of their inheritance remains, by and large, an enigma.¹ Young flower-buds obtained from 'double flowers' of hollyhock were cultured to study their developmental pattern *in vitro*.

Out of a large colony of hollyhock plants that were raised in the botanical garden of Jodhpur University a few produced 'double flowers'. These

flowers possessed at least ten petals and the anthers indicated polyadelphous condition in contrast to the usual and more common monoadelphous one. In few buds the latter condition was also observed. The present report forms a part of our observations on the *in vitro* growth of young flower-buds obtained from such a source and concern the differentiation of petals from the anthers.

Young flower-buds (12×8 mm.) were excised from the plants and aseptically inoculated onto the basal medium² as well as on media that contained various combinations of certain growth substances. The cultures were generally incubated at $26^\circ\text{C} \pm 1^\circ\text{C}$. and received diffuse laboratory light.

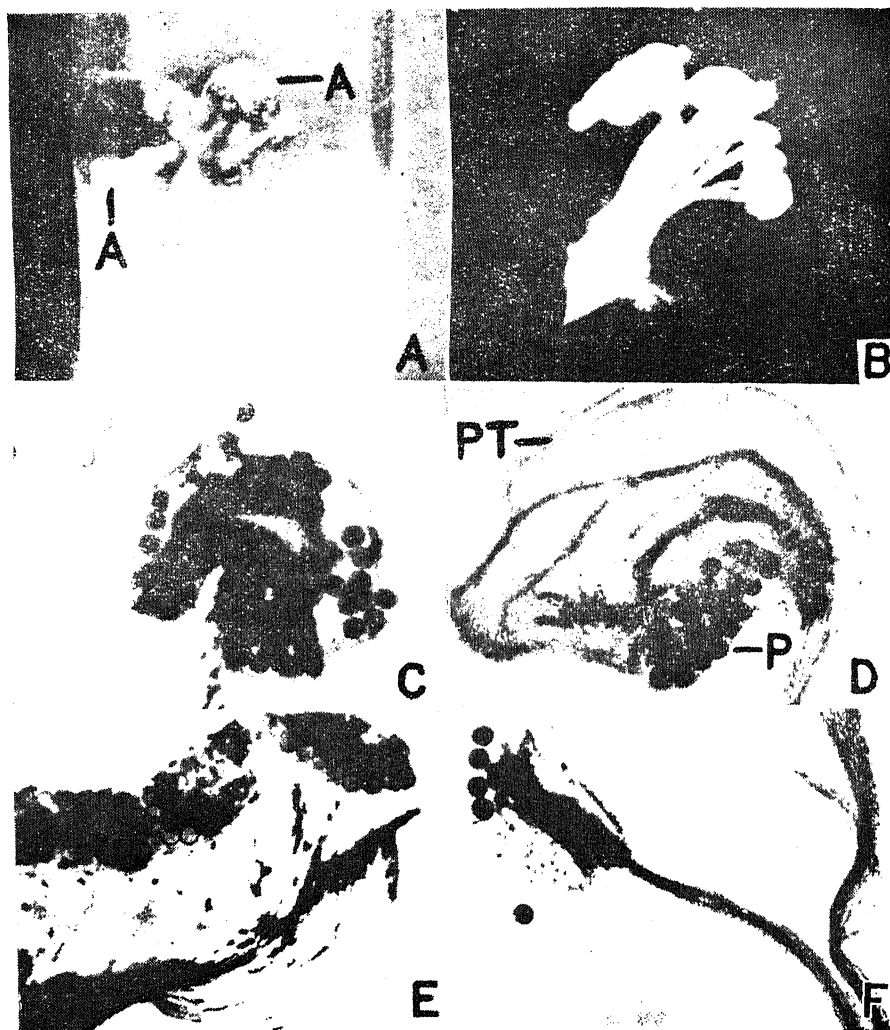


FIG. 1 (A-F). A. Hollyhock bud showing polyadelphous condition. B. A whole mount showing transformation of anthers into petals. C. An anther extending in its dimensions. D, E, F. Some stages of the transformation of anthers into petals. (A, anther; P, pollen; PT, petal.)

The buds responded well in culture and within a week after inoculation miniature flowers were seen peeping in the culture tubes. In some of the tubes the buds *in vitro* also indicated a polyadelphous condition (Fig. 1, A). In few of them even the petals started proliferation. Out of the various combinations of growth substances tried, the one containing IAA (5 ppm), kinetin (0.5 ppm), traces of boric acid and vitamins proved of interest. The most interesting aspect of these cultures concerned the behaviour of stamen. In some of the culture slants the filaments elongated in their longitudinal extension, the anthers increased in their dimensions (Fig. 1, C), and few of these became flat and got transformed into petals (Fig. 1, D, E). Almost a complete series of such transformation of anthers to petals could be traced (Fig. 1, B, D, E). Even cases where a part of the forked filament developed into anther and the other into petal were also discernible (Fig. 1, F).

Many instances are known in nature that clearly indicate that anthers and petals are homologous to each other. Our studies possibly indicate that the 'anther-to-petal' transformation can be achieved even artificially on a well-defined media. However, it should be admitted that the exact mechanism of this transformation is not known and with the evidences in hand, presently it would be too premature to link this transformation with the presence of kinetin and boron in the media. Nonetheless, it is apparent that tissue culture technique might well be exploited in studying the chemical basis of developmental pattern of the 'double flowers'.

Botany Department, N. SANKHLA.
University of Jodhpur, MISS DAKSHA BAXI.
Jodhpur, April 9, 1966. U. N. CHATTERJI.

1. Rana, R. S., "Genetics of double flowers," *Sci. Cult.*, 1965, **11**, 560.
2. Chatterji, U. N. and Sankhla, N., "Effect of growth substances on the mature embryo of *Merremia dissecta* (Jacq.) Hallier f. cultivated *in vitro*," In *Tissue Culture* (Ed. C. V. Ramakrishnan), Dr. W. Junk, Publishers, The Hague, 1965, p. 389.

OCCURRENCE OF A FUNGAL PARASITE *ASCHERSONIA PLACENTA* BERKELEY AND BROOM ON THE SUGARCANE WHITEFLY, *ALEUROLOBUS* *BARODENSIS* MASK.

RAMACHANDRACHARI *et al.*¹ recorded the occurrence of *Aschersonia* sp. on the sugarcane whitefly, *Aleurolobus barodensis* Mask., from Andhra Pradesh.

Observations on sugarcane pests in Tanjore area during 1963-64 showed that a species of fungus, *Aschersonia placenta* Berkeley and Broom, parasitised the nymphs and puparia of the sugarcane whitefly, *A. barodensis*. The attack of the fungus started with the start of monsoon showers in October when the mean atmospheric humidity ranged between 85 and 95%, and the maximum and minimum temperatures ranged between 27.5 to 36.5° C. and 20.0 to 24.0° C. respectively. The fungus continued to infest the whitefly nymphs and puparia till February next. The mortality among the parasitised individuals in some fields was very high ranging from 68 to 100%.

Recently similar fungal attack has been observed on the nymphs and puparia of *A. barodensis* in Plassey area of West Bengal as observed during August-September 1965. According to Mains² an allied N. American sp., *Aschersonia aleyrodis* Webber occurs in both perfect and imperfect stages. But in case of *A. placenta*, only the asexual stage has so far been observed. It was interesting to note that the fungus did not attack the other species of whitefly, *Neomaskellia bergii* Sign. though its attack occurred in the neighbourhood. The infested nymphs and puparia succumbed to the attack, and the fungus multiplied and sporulated profusely thereon.

The fungus was identified by the Department of Invertebrate Pathology, University of California, Berkeley, to whom our thanks are due.

Indian Institute of Sugarcane A. N. KALRA.
Research, H. DAVID.
Lucknow, May 16, 1966. D. K. BANERJI.

1. Ramachandrachari, C., *et al.*, *Madras Agri. J.*, 1959, **46**(7), 270.
2. Mains, E. B., *Jour. Insect Path.*, 1959, **1**, 43.

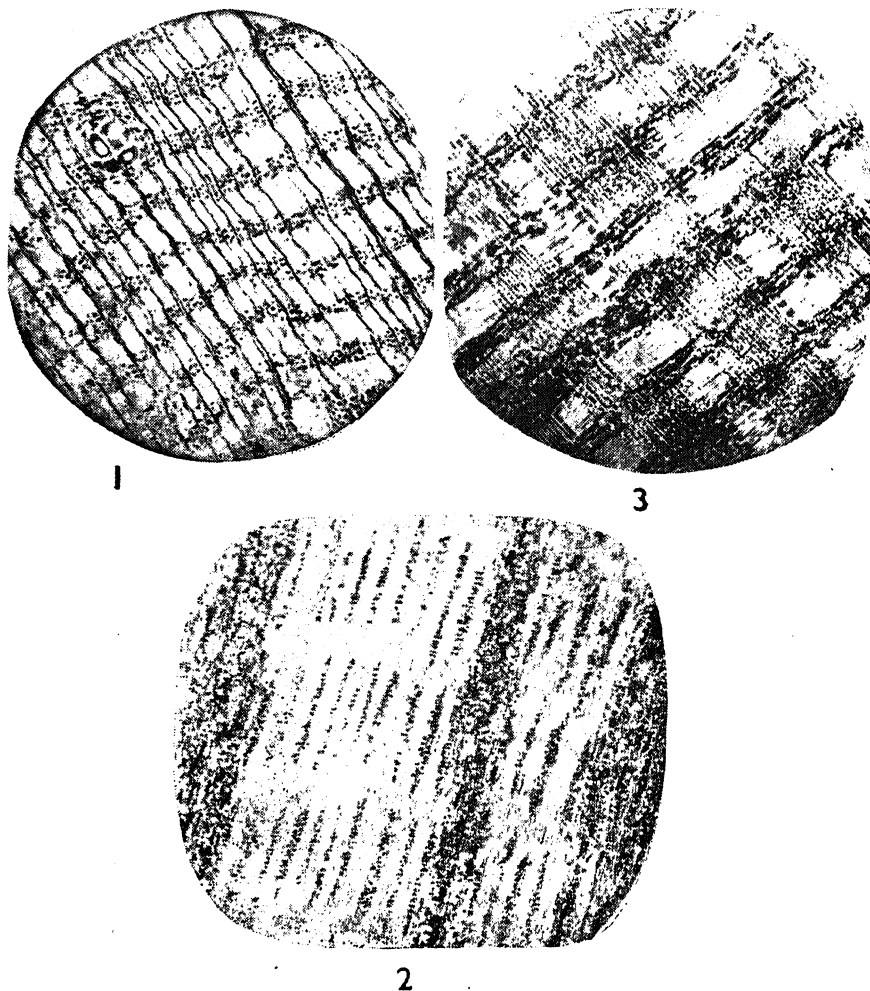
A FOSSIL WOOD RESEMBLING *BAUHINIA* FROM THE CUDDALORE SERIES OF SOUTH INDIA

THE recent xylotomical studies of the silicified woods of Cuddalore sandstones of South Arcot District, Madras, have brought to light the abundant occurrence of Leguminous fossils in these sediments.¹⁻⁴ The Leguminous woods known so far from the Cuddalore series (U. Miocene) are *Acacioxylon*, *Albizioxylon*, *Pahudioxylon*, *Cesalpinioxylon*, *Cassioxylon*, *Cynometroxylon*, *Dalbergioxylon*, and *Pterocarpoxylon*. The present communication records for the first time a ligneous fossil from Mortandra near Pondicherry, resembling the wood of modern *Bauhinia*.

The following are the important anatomical characters of the fossil wood (M 65).

Wood diffuse-porous, growth rings indistinct, vessels predominantly solitary, sometimes in radial pairs and rarely in groups of three, t.d. 125-175 μ . Vessels either completely embedded in the bands of parenchyma or fibres, or sur-

thick, regularly alternating with bands of parenchyma and non-septate. Xylem rays one or two cells thick, 10-22 cells high and distinctly storied (Fig. 2); rays mostly heterogeneous with a single marginal row of vertical cells (Fig. 3). Ripple marks very fine and fairly distinct on the tangential facets of fossil specimen.



FIGS. 1-3, $\times 35$.

rounded partly by parenchyma and partly by fibres. Perforations simple, end walls inclined, pits to the vessels angular, alternate and bordered. Parenchyma very abundant, clearly seen with unaided eye, and mostly aligned in regular tangential, more or less sinuous bands, 60-80 per inch, each band being 4-8 cells thick (Fig. 1). Thin vasicentric sheaths of parenchyma also seen occasionally. Parenchyma cells storied and filled with dark contents. Fibres, in distinct tangential bands of 9-12 cells

The regularly banded nature of the xylem parenchyma and fibres would apparently suggest similarities of the fossil with *Cynometroxylon* known previously from the same area.⁵ The storied nature of the rays and parenchyma and the occurrence of fine ripple marks in the present fossil would, however, clearly indicate its xylotomical relationships with the wood of *Bauhinia*.

Bauhinioxylon indicum from the Miocene Siwalik beds of Uttar Pradesh has been the only

fossil wood of *Bauhinia* known so far from India.⁶ However, as no description of the above fossil wood was given by its author, it has not been possible to compare the South Indian fossil with the Siwalik specimen.

Almost all the ligneous fossils recorded so far from the Cuddalore series point towards a tropical climate with plenty of rainfall during the Mio-Pliocene of South India. The present record of *Bauhinia*, a typically tropical taxon, if anything further corroborates the existence of tropical climate during the above period.

We are thankful to Prof. M. R. Suxena for his kind interest and encouragement and to the Director-General of G.S.I., Calcutta, for the facilities provided for the sectioning of the fossil.

Department of Botany, C. G. K. RAMANUJAM.
Osmania University, M. RAGHU RAMA RAO.
Hyderabad-7 (A.P.),
May 4, 1966.

1. Ramanujam, C. G. K., *The Palaeobotanist*, 1954, 3, 40.
2. —, *Palaeontographica*, 1960, 106B, 101.
3. Navale, G. K. B., *The Palaeobotanist*, 1958, 7, 6.
4. —, *Ibid.*, 1963, 11, 54.
5. Ramanujam, C. G. K. and Raghu Rama Rao, M., *Curr. Sci.*, 1966, 35, 158.
6. Rawat, M. S., *Abst. Proc. Ind. Sci. Congress*, 51st and 52nd Sessions, 1964.

OBSERVATIONS ON HYDROGEN PHOSPHIDE AS A NEMATOCIDE

It is known that phosphine is extremely toxic to a number of insect pests of storage.¹⁻³ It was thought worthwhile to study the effect on nematodes of the commercial product phostoxin which liberates phosphine. The German manufacturers have not pointed out the toxic effects to nematodes in their booklet *Phostoxin*, a DEGESCH publication.

The preliminary investigation was taken up to study the efficacy of phostoxin against nematodes attacking *Amaranthus* sp. Egg masses were collected from the affected roots of the plants and were kept in the laboratory in water at $26^{\circ} \pm 1^{\circ}$ C. for hatching. Two days after hatching twenty-five nematode larvæ were kept in one glass cavity block and three such blocks were kept inside glass jars of capacity

of 1,350 ml. which were used as fumigation chambers. All care was taken to prevent leakage of the gas from the jars. Approximately 1/4th of a tablet (0.78 gm.) of phostoxin was introduced in glass tubes having moist cotton to provide moisture for decomposition of the tablet, into each of the three glass jars but one jar contained only nematode larvæ without any fumigant. At the end of each exposure period of 24, 48 and 72 hours the nematode larvæ removed from one of the jars were examined under a microscope. The water from the treated cavity blocks was transferred to other glass containers in which five active nematode larvæ were left for observation. Mortality was taken 24, 48 and 72 hours after they were incubated in water. The data are presented in Table I. It was seen that there was high

TABLE I
Mortality of nematode larvæ when treated with phostoxin

Exposure period hours	Dosage of phostoxin per 1,350 ml. (gm.)	Average % death	Average % death in treated water
24	0.78	96	80
48	0.78	100	100
72	0.78	100	100

percentage mortality in both the experiments and there was no mortality in the untreated control. The results indicate that phosphine is toxic to nematodes attacking *Amaranthus*. Probably the gas was absorbed by water in which the nematodes could not survive. This throws some light on the possibility of utilising phostoxin against soil nematodes. Detailed investigations are necessary on the subject.

Agriculture College,
O.U.A., Bhubaneswar,
March 31, 1966.

G. Rout.

1. Bond, E. J. and Monro, H. A. V., *J. econ. Ent.*, 1961, 5A (3), 451.
2. Heseltine, H. K. and Thompson, R. H., *The Use of Aluminium Phosphide Tablets for Fumigation of Grains*, 1957, Milling, Part I, Vol. 129, 676.
3. Lindgren, D. L., Vincint, L. E. and Strong, R. C., *J. econ. Ent.*, 1958, 51 (6), 900.

REVIEWS AND NOTICES OF BOOKS

The Biology of Mind. By W. R. Hess. M.D. (Translated from the German by Gerhardt Von Bonin.) (The University of Chicago Press, Chicago and London), 1964. Pp. xii + 203. Price \$6.00.

Walter Ruduolf Hess, Professor Emeritus of Physiology at the University of Zurich and the author of this book, has devoted most of his life to research in the physiology of the nervous system, particularly of the autonomic nervous system. It was for his great contributions in this field that he was awarded the Nobel Prize in Physiology and Medicine in 1949.

The Biology of Mind is a summation and integration of his experimental results and concepts in the general area of psychophysiology. First published in Stuttgart in 1962, the book now appears in an authoritative translation by Gerhardt Von Bonin, himself an Emeritus Professor of Neurology and author of *The Evolution of the Human Brain*.

Here is Dr. Hess's systematic presentation of the problems of brain mechanisms and behaviour and the correlation between neuronal and psychic processes. The first part deals with the psychological functions which can be achieved by man and highly organized animals. Ways of behaviour are connected with the contents of consciousness. Drives which originate in vegetative needs have as their consequences prehensive or, alternatively, protective behaviour. In the second part the author elucidates the connection between these physically induced effects and the functional organization of the brain and reviews experimental work on the nervous system. The third section summarizes and interrelates the two themes. C. V. R.

Quantum Mechanics. By Philip Stehle. (Holden-Day, Inc., 728, Montgomery Street, San Francisco), 1966. Pp. viii + 263. Price \$10.75.

This text provides the student with a thorough working knowledge of quantum mechanics. The book formulates quantum mechanics in terms of transformation theory, which permits the student to go immediately to the representation best suited to the particular problem at hand. Among the many outstanding features are an unusually complete treatment of scattering, including inelastic scattering; extensive use of the occupation number representation; modern and thorough coverage of perturbation theory;

detailed discussion of symmetry operations; an up-to-date description of meaning of identical particles; and a comprehensive treatment of angular momentum. The scope of the book is that of non-relativistic quantum mechanics. Many applications are discussed in detail.

C. V. R.

An Introduction to Linear Analysis. By D. L. Kreider, Robert G. Kuller, D. R. Ostberg and F. W. Perkins. (Addison Wesley Publishing Company, Inc.), 1966. Pp. xv + 773. Price \$8.50.

This book, which assumes a background in calculus, is designed to serve as an introductory text in applied analysis for students of science and engineering. Covering much of the traditional material, it also treats topics which are of importance in present-day mathematics. The concept of linearity is emphasized and used as the unifying thread which ties together the treatment of topics often presented in an isolated manner. Conceptual understanding is stressed throughout, particularly through the detailed discussions of vector spaces and linear transformations in the solution of physical problems.

The titles of the chapters contained in this book are as follows: Real Vector Spaces; Linear Transformations and Matrices; The General Theory of Linear Differential Equations; Equations with Constant Coefficients; The Laplace Transform; Further Topics in the Theory of Linear Differential Equations; Euclidean Spaces; Convergence in Euclidean Spaces; Fourier Series; Convergence of Fourier Series; Orthogonal Series of Polynomials; Boundary-Value Problems for Ordinary Differential Equations; Boundary-Value Problems for Partial Differential Equations: The Wave and Heat Equations; Boundary-Value Problems for Laplace's Equation; Boundary-Value Problems Involving Bessel Functions. C. V. R.

Text-Book of Elementary Psychology. By Eugene Galanter. (Holden-Day, Inc., 728, Montgomery Street, San Francisco), 1966. Pp. xiii + 419. Price \$8.75.

This text employs a mathematically and philosophically sophisticated approach to develop a coherent image of psychology in which conceptions and problems are more relevant than

facts and data. After an initial consideration of method, the book explores the problem of choice—the nature of the mind of an organism that constrains actions in the face of a well-defined but arbitrary set of behavioural alternatives. The framework here is an enlightened stimulus-response psychology.

A transitional chapter on time measures of behaviour serves to introduce the second major problem considered, that of organization. Within the context of Gestalt psychology and cognitive theory, the book examines how the mind of an organism sorts out theoretically undifferentiated events into a well-defined collection of motives, percepts, and action. Designed as a freshman-sophomore introductory text-book, it is also suitable for use in more advanced courses such as Mathematical Learning Theory or Mathematical Psychology.

C. V. R.

The Proteins (Vol. 4). (*Composition, Structure and Function*), Second Edition. Edited by Hans Neurath. (Academic Press, New York and London), 1966. Pp. xv + 508. Price \$ 20.00.

The first of the three chapters of the present volume concerns a subject which may be said to be the core of modern biology. It deals with the genetic determination of protein structure and with the effects of mutational alteration on the structure and function of proteins. A highly relevant aspect of this topic is the change in protein structure during evolution and cell development. A discussion of such a rapidly moving field, by its very nature, is always timely and never complete. The second chapter deals with the glycoproteins, an important topic which was not explicitly dealt with in the first edition. The present volume is concluded by a discussion of a group of proteins; by community of general structure they are usually considered together as the "structure proteins". The body of information is large and complex, and the structural functions which these proteins fulfil are diverse. It is fitting, therefore, that this chapter occupies a major portion of this volume.

C. V. R.

Introduction to Nuclear Reactor Theory. By John R. Lamarsh. (Addison Wesley Publishing Company, Inc.), 1966. Pp. xi + 585. Price \$ 15.00.

This book is based on a one-year course in Nuclear Reactor Theory taught by the author over a ten-year period. The text is intended to provide an understanding of the physical principles underlying the operation of a nuclear reactor, and to offer the student the knowledge

to perform some of the more elementary calculations necessary in reactor design. The prerequisites of advanced calculus and nuclear physics are assumed.

Emphasizing teachability, the author has made an effort to address himself to the teacher as well as to the student. Physical principles are explained quantitatively, and many of the modern methods for handling reactor calculations are discussed. There are 361 graded problems.

The following is a list of the titles of the chapters contained in this book: Review of Nuclear Physics; Interaction of Neutrons with Matter; Nuclear Fission; Neutron Chain-Reacting Systems; The Diffusion of Neutrons; Neutron Moderation without Absorption; Neutron Moderation with Absorption and Fission; Low-Energy Neutrons; Fermi Theory of the Bare Thermal Reactor; Multiregion Reactors—The Group Diffusion Method; Heterogeneous Reactors; Reactor Kinetics; Changes in Reactivity; Control Rods; Perturbation Theory.

C. V. R.

Proceedings of the Ninth International Conference on Cosmic Rays (Two Volumes). (The Institute of Physics and the Physical Society, 47, Belgrave Square, London S.W. 1), 1966. Pages Vol. 1, xxv + 1-608; Vol. 2, 609-1113. Size 20 × 29 cm. Price £ 10-10 set.

The biennially held International Conference on Cosmic Rays dates back to 1947 when the first Conference was held in Cracow. The venue of the Conference shifts through countries noted for major work in Cosmic Ray Research. It will be recalled that the Eighth Conference was held in Jaipur, India, in 1963.

The Ninth International Conference on Cosmic Rays, held under the auspices of the Cosmic Ray Committee of the International Union of Pure and Applied Physics in conjunction with the Institute of Physics and the Physical Society, was held at the Imperial College, London, in September 1965. This was the first time that the Conference was held in the United Kingdom.

The Proceedings of the Conference have been promptly brought out by the organisers in the two volumes under review. They contain the texts of 14 invited papers, 293 contributed papers, and 7 rapporteur surveys. The arrangement has been conveniently made according to subject under the following chapter headings:—Volume 1: Invited Papers (12), Acceleration (14), Modulation (47), Spectral Composition (45), Geophysical Effects (36), Isotopic Distribution (4). Volume 2: Invited Papers (2),

Extensive Air Showers (60), High Energy Interactions (37), Muons and Neutrinos (41), Techniques (17). The portrait of Professor P. M. S. Blackett, himself a great cosmic ray scientist whose retirement from his Chair in Physics at the Imperial College coincided with the time of the Conference, is displayed as the frontispiece of this publication.

As the contributions come mostly from working groups on various aspects of cosmic ray research, distributed throughout the world, they represent the latest developments and the twin-volume publication must be an essential addition to all scientific libraries. A. S. G.

Britain: An Official Handbook 1966. Pages 590. Price Rs. 14.00 plus postage. Available from the Manager, HMSO Sales Section, British Information Services, Chanakyapuri, New Delhi.

The Official Handbook on Britain supplied by the British Information Services is well known as an established work of reference. The current number for the year 1966, revised and made up-to-date, provides factual information on nearly all matters an interested person would like to know about Britain, its administration and economy. A large scale Ordnance Survey Map of Great Britain and Northern Ireland is supplied as supplement to the publication.

The Impact of Mendelism on Agriculture, Biology and Medicine.*

Volume 26 A (1966) of the *Indian Journal of Genetics and Plant Breeding* is a special number devoted to the Proceedings of the Third International Symposium on "The Impact of Mendelism on Agriculture, Biology and Medicine". The Symposium, which was held at the Indian Agricultural Research Institute, New Delhi, on February 15 to 25, 1965, was to commemorate two events, namely, the Twenty-Fifth Year of the Indian Society of Genetics and Plant Breeding, and the Centenary of Mendel's discovery of the laws of heredity.

The volume opens with the welcome address of Dr. B. P. Pal, Director, IARI, and is followed by the three lectures delivered at the first session of the Symposium: "On the Evolution

* *The Impact of Mendelism on Agriculture, Biology and Medicine*: (Special Symposium Number Volume 26A of *The Indian Journal of Genetics and Plant Breeding*.) Editor: S. Ramanujam. (Published by the Indian Society of Genetic and Plant Breeding, New Delhi), Pp. xxii + 486. Price Rs. 30.

and Breeding of Cultivated Plants" by A. Muntzing of the Institute of Genetics, University of Lund, Sweden; "Factors affecting the Evolution of Common Wheat" by H. Kihara of the National Institute of Genetics, Japan; and "The Origin of Macro from Micro-mutations and Factors governing the Direction of Micro-mutational Changes" by M. S. Swaminathan of the Indian Agricultural Research Institute, New Delhi, India.

The papers presented and discussed at the various sessions of the Symposium are grouped under the following heads: Genetics and Plant Breeding—17 papers; Cytogenetics—7 papers; Mutations in Higher Plants—5 papers; Human and Animal Genetics—6 papers; Biochemical and Molecular Genetics—5 papers.

The six papers of the panel discussion on "Teaching of Genetics and Plant Breeding" are included in the last section of the volume. The volume closes with some photographs of the Cultural Entertainment programme, "The Secret of Life"—(A Ballet in four scenes).

The 500-page Special Number of the *Indian Journal of Genetics and Plant Breeding*, containing more than 40 papers contributed by nearly seventy active workers and giving the latest developments and results on various aspects of plant breeding and genetics, will be a welcome addition not only to institutional libraries but to concerned individual workers—also. A. S. G.

Books Received

Chemical Society Special Publication No. 20—Molecular Relaxation Processes. (The Chemical Society, Burlington House, London), 1966. Pp. ix + 304. Price 65 sh.

International Review of Cytology (Vol. 19). Edited by G. H. Hourne and J. F. Danielli. (Academic Press, Inc., New York), 1966. Pp. ix + 419. Price 17.00.

Experiments in General Chemistry—A Laboratory Text. By C. N. R. Rao and U. C. Agarwala. (Affiliated East West Press P. Ltd., C. 57, Defence Colony, New Delhi), 1966. Pp. v + 221. Price Rs. 9.50.

Deductive Organic Chemistry a Short Course. By K. Conrow and R. N. McDonald. (Addison Wesley Publications Co., Reading, Mass.) Pp. xviii + 405. Price \$ 6.00.

Human Ecology Collected Readings. By J. B. Bresler. (Addison Wesley Publications Co., Reading, Mass.), 1966. Pp. viii + 472. Price \$ 9.75.

SYMPOSIA ON IRREVERSIBILITY AND TRANSFER OF PHYSICAL CHARACTERISTICS IN A CONTINUUM

B. R. SETH

The University, Dibrugarh

THE treatment of modern problems like elastic-plastic deformation, creep, fatigue, turbulence, random and multiple component media involve irreversibility and thermodynamic effects. They have wide applications in all branches of science and technology. This year, the International Union of Theoretical and Applied Mechanics, therefore, sponsored two Symposia on these subjects. They were held in Vienna at the Technical Museum from June 22nd to 29th, 1966. 28 papers were presented. Those who took part in it included: (1) L. I. Sedov (Moscow); (2) C. Truesdell (Baltimore); (3) B. R. Seth (Kharagpur); (4) D. C. Drucker (Providence); (5) A. M. Freudenthal (New York); (6) S. Kaliski (Warszawa); (7) E. H. Lee (Stanford); (8) J. Meixner (Aachen); (9) P. M. Naghdi (Berkeley); (10) W. Nowacki (Warszawa); (11) W. Olszak (Warszawa); (12) W. Prager (La Jolla); (13) M. Reiner (Haifa); (14) Yu. N. Rabotnov (Moscow); (15) R. S. Rivlin (Providence); (16) Yu. P. Lunken (U.S.S.R.); (17) F. N. Frenkiel (U.S.A.); (18) V. N. Nikoleski (U.S.S.R.); (19) B. D. Coleman (Pittsburgh); (20) G. K. Batchelor (Cambridge); (21) M. J. Lighthill (London).

The first symposium on "Irreversible Aspects in Continuum Mechanics" opened with a paper by L. I. Sedov and the second on "Transfer of Physical Characteristics in Moving Fluids" with a paper by B. R. Seth.

L. I. Sedov stressed the need of using generalised variational methods for construction of new models of complicated physio-chemical nature, having finite degrees of freedom. He formulated the basic equation in the form

$$\delta \int L d\tau + \delta W + \delta W' = 0,$$

where $d\tau$ is the element of arbitrary four-dimensional space-time "volume" V bounded by the three-dimensional surface Σ ; $L(q_i, \nabla_j q_i)$, a generalized Lagrangian function. The variable q_i and their corresponding gradients $\nabla_j q_i$ form a system of determining parameters.

Then we have

$$\delta W = \int_V Q_i \delta q_i d\tau + \int_{\Sigma} Q_j^i \delta q_i \eta^j d\sigma,$$

and

$$\delta W = \int_{\Sigma} p_j^i \delta q_i \eta^j d\sigma,$$

where η^i are components of the unit vector of the external normal to Σ and $d\sigma$ is an element of the surface Σ .

In most of the other papers, participants discussed particular models bringing into prominence the thermodynamic effects. It was pointed out that Onsager's relations, which hold good only for small deviation from the equilibrium position could not be used in problems like elastic-plastic deformation and creep. It was also stressed that they could not be used in non-linear problems. H. Ziegler gave a recast of these relations by establishing a criterion for the choice of fluxes or forces, and by replacing them by a physically significant maximum principle applicable to non-linear cases.

C. Truesdell showed that the classical thermodynamic theory can be presented in a simple explicit form based on the two axioms of

- (1) the balance of energy;
- (2) the Clausius-Planck inequality.

Thermodynamic materials can then be defined by constitutive equations, and all classical problems can be readily solved.

B. D. Coleman and M. E. Gurtin showed that one-dimensional wave propagation in non-linear thermodynamic materials with memory, like shock-waves, can be readily treated by generalizing the theories of Hugoniot and Duhem. S. Kaliski showed how generalized Onsager's relations could be used for interaction fields like Cerenkov generation of thermo-waves and thermo-electro-magneto-elasticity, while W. Olzack used the theory of simple materials to discuss media of a differential type.

The first and second laws of thermodynamics figured prominently in the discussions and generated a lot of heat. A number of participants thought that they should be suitably modified for continuum problems. R. S. Rivlin showed how the thermo-mechanical field equations may be obtained from these laws by making some specific assumptions regarding the invariance of generalised co-ordinates under rigid motions.

In a non-equilibrium continuum J. Meixner made out that the concept of entropy should be discarded while J. Kestin showed that in strained solid materials some independent thermodynamic parameters must be identified.

For finite plastic deformations, E.T. Onat also found that state variables are necessary. J. F. Besseling wanted that a distinction be made between thermodynamical systems and those dealing with boundary value problems. He showed that a continuum theory of deformation and flow can be based on the principle of conservation of mass, the two laws of thermodynamics, the concepts of a local thermodynamic state and a local geometric natural reference state, a principle of determinism and on a postulate concerning the production of entropy.

Thermodynamical effects and irreversibility in elastic-plastic problems, creep and rupture were discussed by W. Prager, E. H. Lee, P. M. Naghdi, G. S. Shapiro, B. R. Seth, Ju. N. Rabotnov, Jan Hult, M. Reiner and others. B. R. Seth showed that, contrary to current concepts conditions of state and jump conditions could be obtained from the field equations by treating them as asymptotic solutions at the

transition points of the differential system defining the field. He showed how jump conditions for shock waves, yield conditions for elastic-plastic deformation and creep conditions like those of Norton's law could be obtained.

W. Nowacki extended the coupled-stresses theory of thermo-elasticity to that of a homogeneous Cosserat's medium and obtained a generalization of the Galerkin method for the corresponding dynamical system. An accumulating second order effect on strain-hardening aluminum specimens in reversed torsion was pointed out by A. M. Freudenthal and M. Ronay. This should be treated as a transition phenomenon and not explained by a particular type of constitutive equation. M. J. Lighthill discussed the interesting example of a Cosserat's fluid medium having a gas bubble.

The Proceedings of the Symposia will be published by SPRINGER-VERLAG under the Editorial Chairmanship of Prof. Dr. Heinz Parkus of Vienna.

RADIAL PARTICLE PROFILE IN NEGATIVE GLOW NEON PLASMA

V. T. CHIPLONKAR AND Y. R. DESAI

Ion Physics and Electronics Laboratory, Institute of Science, Bombay-1

In a steady-state plasma, where the losses of charge carriers are governed mainly by the diffusion processes, the general particle balance equation can be put as:

$$D_a \nabla^2 n_e + \nu_i n_e = 0 \quad (1)$$

where D_a = coefficient of ambipolar diffusion; ν_i = rate of collisional ionization referred to an average plasma electron, and n_e = plasma electron density. Here it is assumed that the dominant process of secondary ionization in the plasma volume is due to electron collisions and is therefore dependent on the density n_e . The solution of (1) for the case of a cylindrical plasma, considering only the radial boundary conditions, was shown by Schottky¹ to give a distribution represented by a Bessel function.

$$n_r = n_0 J_0(br) \quad (2)$$

where $b = (\nu_i/D_a)^{1/2}$ and n_0 = particle density along the tube axis. Schottky's theory was given for the positive column part of the plasma where the motions of the charge carriers are sufficiently randomized. The negative glow plasma in a highly abnormal discharge is mainly generated by an approximately monoenergetic beam of electrons arriving from the cathode fall

region. If the energy of the incoming electrons is very high compared with the average energy lost in an ionizing collision, the secondary ionization rate in the negative glow space becomes uniform and independent of the particle density n_e . Such a situation, as pointed out by Persson,² leads to a well-behaved laboratory plasma. For a uniform electron beam with energy enough to make the reaching distance² $L \gg R$ (R = radius of container) and to cause ionization at a constant rate along its length, the charge carriers so produced are lost either by ambipolar diffusion or by volume recombination. Persson² has shown that the radial particle profile for the diffusion limited case (neglecting recombination) is parabolic in form.

We have observed the radial density profile in Neon ($p = 260 \mu$; $i_{dc} = 4.5$ mA; $V_{dc} = 1160$ V) by the double-probe method,³ when both the probes were in the negative glow plasma; the plasma was generated in a cylindrical discharge tube (Pyrex, radius $R = 1.3$ cm.). The exploring probe was moved radially from the geometrical position of the wall to the axis of the tube by a micrometer screw movement.

Following Persson, we assume an expression of the type

$$\frac{n_r}{n_0} = A \left[B - \left(\frac{r}{R} \right)^2 \right] \quad (3)$$

where A and B are constants which can be determined from the boundary conditions, $n_r = n_R$ at $r = R$ and $n_r = n_0$ at $r = 0$. n_R represents the observed particle density when the movable probe occupies the geometrical position of the wall. Equation (3) can then be written as

$$\frac{n_r}{n_0} = (1 - N) \left[\left(\frac{1}{1 - N} \right) - \left(\frac{r}{R} \right)^2 \right]$$

where $N = n_R/n_0$. For the present case $n_R = 1.72 \times 10^9 \text{ cm}^{-3}$ and $n_0 = 2.88 \times 10^9 \text{ cm}^{-3}$, which gives the values of the constants as $A = 0.4$, $B = 2.5$. Figure 1 (solid curve) gives the corresponding distribution. The Bessel function profile for the same experimental data is given in Fig. 2 (solid curve) which is calculated on the basis that $n_R \neq 0$ but has the value observed with the help of the movable probe as mentioned above. Thus it can be seen from Figs. 1 and 2 that the observations appear to be capable of representation both by a parabolic distribution as well as by a Bessel function. This fact can be interpreted to mean that ionization is not restricted to only the high energy electrons (\approx monoenergetic) coming from the cathode dark space. It appears therefore that the negative glow plasma investigated has a status intermediate between that of a positive column plasma and a negative glow beam plasma (where the parabolic distribution alone should be valid).

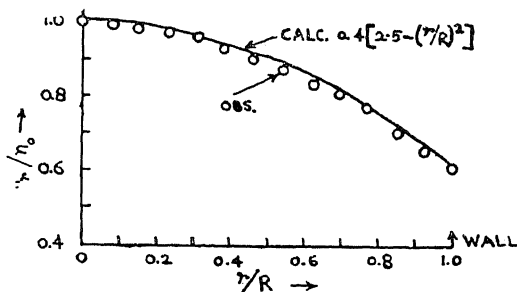


FIG. 1. Radial particle density profile in the negative glow neon plasma compared with parabolic function.

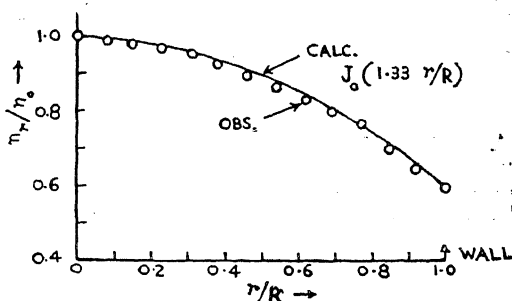


FIG. 2. Radial particle density profile in the negative glow neon plasma compared with Bessel function.

One of us (Y. R. D.) is indebted to the Government of Maharashtra for the award of a Junior Research Fellowship.

1. Francis, G., *Hand. d. Physik.*, 1956, **22**, 122.
2. Persson, K. B., *J. Appl. Phys.*, 1965, **36**, 3086.
3. Johnson, E. O. and Malter, L., *Phys. Rev.*, 1950, **80**, 58.

X-RAY ANALYSIS OF IMPERFECTIONS IN DEFORMED RHODIUM

S. D. SINGH AND T. R. ANANTHARAMAN

Department of Metallurgy, Banaras Hindu University, Varanasi

BROADENING of X-ray powder reflections from cold-worked rhodium was first analysed by Brindley and Rindley¹ and the conclusion drawn that lattice strain alone contributes to the observed broadening. No further attempt has, however, been made in the last two decades to examine the possible incidence of stacking faults on deforming rhodium and to separate quantitatively the contributions due to domain size and lattice strain. The present note deals with an accurate determination of deformation stacking faults in cold-worked rhodium powder and an

evaluation therefrom of the values of domain size and lattice strain.

High-purity (> 99.99%) rhodium powder was deformed at room temperature for an hour in a mechanical pulveriser and was then pressed in the form of briquettes for mounting in a Philips X-ray Diffractometer. Line profiles of the (111), (200), (311) and (222) reflections were recorded from such briquettes at a scanning rate of $1/8^\circ$ per minute and a time constant of 4 seconds. The briquette was then annealed in vacuum and the same line profiles recorded

TABLE I

Analysis of X-ray line broadening in cold-worked rhodium powder. Results corrected for stacking faults

$$(\alpha = 1.9 \times 10^{-3})$$

Reflection	$2\theta^\circ$	$b \times 10^3$ rad.	$b_{\text{corr.}} \times 10^3$ rad.	$B \times 10^3$ rad.	$\beta_s \times 10^3$ rad.	$\epsilon_s \times 10^3$	$\eta_s \text{ \AA}$	$\beta_{\text{AC}} \times 10^3$ rad.	$\epsilon_{\text{AC}} \times 10^3$	$\eta_{\text{AC}} (\text{ \AA})$	$\beta_{\text{WB}} \times 10^3$ rad.	$\epsilon_{\text{WB}} \times 10^3$	$\eta_{\text{WB}} (\text{ \AA})$
111	20.53	1.52	1.66	3.79	2.13	1.39	772	3.06	2.04	537	3.40	2.27	484
200	23.88	1.57	1.82	4.81	2.99	1.69	561	4.12	2.32	409	4.45	2.51	378
311	42.20	3.17	3.35	8.34	4.99	1.38	416	7.00	1.93	297	7.64	2.11	272
222	44.55	3.40	3.58	9.86	6.28	1.59	344	8.56	2.17	252	9.18	2.33	235
Mean value	..	..	..	..	..	1.51	523	..	2.11	374	..	2.30	342
Percentage mean deviation from mean value	..	..	..	..	..	8.4	27.0	..	6.1	26.6	..	5.0	25.9

under identical experimental conditions to characterise instrumental broadening.

The location of the a_1 peaks and the determination of the integral breadth of the cold-worked and annealed profiles was done by the method suggested by Anantharaman and Christian.² The deformation stacking fault parameter (α) was determined by the change in separation of the (111) and (200) reflections according to the equation.³

$$\Delta (2\theta_{200} - 2\theta_{111})$$

$$= -\frac{45\sqrt{3}\alpha}{\pi^2} (\tan \theta_{200} + \frac{1}{2} \tan \theta_{111}). \quad (1)$$

A very small value of α , viz., 1.9×10^{-3} , was found in cold-worked rhodium powder.

The breadths (β_i) due to deformation faulting for each of the hexagonal components of any particular f.c.c. reflection could be computed⁴ from the α value. The fault breadths of each of the components were compounded separately with the instrumental breadth (b) by the parabolic equation⁵ to obtain the individual breadths of the components broadened by faulting. Neglecting the small peak shifts of the individual components, the desired fault-corrected instrumental breadth ($b_{\text{corr.}}$) was thereby obtained⁶ from the individual breadths of the components broadened by faulting and their corresponding fractional intensities.

The pure diffraction broadening (β) due only to domain size and lattice strain was obtained from the observed integral breadth (B) by making use of each of the following relations derived by Scherrer,⁷ Anantharaman and Christian⁵ and Warren and Biscoe⁸ on the assumption of Cauchy, intermediate and Gaussian profiles respectively:

$$\beta_s = B - b_{\text{corr.}} \quad (2)$$

$$\beta_{\text{AC}} = B - \frac{b_{\text{corr.}}^2}{B} \quad (3)$$

$$\beta_{\text{WB}} = B^2 - b_{\text{corr.}}^2 \quad (4)$$

The domain size (η) and lattice strain (ϵ) values were obtained by the following well-known relations to check the preponderance of one effect over the other:

$$\eta = \frac{\lambda}{\beta \cos \theta} \quad (5)$$

$$\epsilon = \frac{1}{4} \beta \cot \theta. \quad (6)$$

The separation of domain size and lattice strain values was done by graphical methods⁹⁻¹⁰ assuming line profiles to be Cauchy or Gaussian functions respectively and also by the analytical method due to Rao and Anantharaman.¹¹

The domain size and lattice strain values obtained from equations (2), (3) and (4) are given in Table I. The domain size values after separation by graphical methods were 1250 Å and 1000 Å, while a value of 1130 Å was arrived at by the analytical method. Corresponding values for lattice strain were found to be 1.50×10^{-3} , 1.95×10^{-3} and 2.09×10^{-3} respectively. The very large value (well above 1000 Å) for domain size indicates that broadening due to domain size effect is negligible or very small and isotropic lattice strain is the main contributor to the broadening besides deformation stacking faults ($\alpha = 0.002$). This result is thus in general agreement with that reported much earlier by Brindley and Rindley.¹

The authors are grateful to Dr. B. Dayal, Department of Physics, for the facility to use a Diffractometer. One of us (S. D. S.) would like to express his thanks to C.S.I.R., New Delhi, for the award of a Research Fellowship.

1. Brindley, G. W. and Rindley, P., *Proc. Phys. Soc.*, 1938, **50**, 501.
2. Anantharaman, T. R. and Christian, J. W., *Brit. J. Appl. Phys.*, 1953, **4**, 155.
3. Warren, B. E., *Progr. Met. Phys.*, 1959, **8**, 1-7.
4. Paterson, M. S., *J. Appl. Phys.*, 1952, **23**, 805.
5. Anantharaman, T. R. and Christian, J. W., *Acta Crystl.*, 1956, **9**, 479.
6. —, *Indian Institute of Science, Bangalore, Golden Jubilee Research Volume*, 1959, p. 280.
7. Scherrer, P. and Zsigmondy, R., *Kolloidchem. Beih.*, 3rd Edition, 1920, p. 394.
8. Warren, B. E. and Biscoe, J., *J. Amer. Ceram. Soc.*, 1938, **21**, 49.
9. Hall, W. H., *Proc. Phys. Soc.*, 1949, **62 A**, 741.
10. Wagner, C. N. J. and Aqua, E. N., *Adv. in X-ray Analysis*, Plenum Press, New York, 1964, **7**, 46.
11. Rao, P. R. and Anantharaman, T. R., *Z. Metallk.*, 1963, **54**, 658.

RADIOCARBON DATES OF SAMPLES FROM SOUTHERN NEOLITHIC SITES

D. P. AGRAWAL AND SHEELA KUSUMGAR

Tata Institute of Fundamental Research, Colaba, Bombay-5

IN this paper we present radiocarbon dates of samples from Sangankallu, Hallur, Bainapalli and T. Narasipur. Samples from Utnur (Agrawal *et al.*, 1964) and Tekklakota (Agrawal *et al.*, 1965) were reported earlier. From these, a tentative chronology of the Southern Neolithic seems to emerge, though more samples are needed to confirm it. A brief discussion of the results is given below.

Two dates in years B.P. (before present) are given for each sample: the first one is based on carbon-14 half-life of 5568 years; the other—within brackets—is based on the half-life value of 5730 years. For changing them to A.D./B.C. scale, 1950 A.D. should be used as reference year. For intercomparisons dates based on the same half-life should be used.

Samples were manually cleaned to get rid of rootlets and other extraneous matter. Soil-carbonates in the sample were removed by 1% HCl treatment. Relatively harder charcoal samples alone were given NaOH treatment to remove humic acid. Gas proportional counters were used to count methane synthesised from the samples. For modern reference 95% activity of N.B.S. oxalic acid was taken as standard. Techniques employed have been described in detail earlier (Kusumgar *et al.*, 1963; Agrawal *et al.*, 1965).

GENERAL DISCUSSION*

Although the age determinations made so far for the Neolithic of the South are not numerous, they already reveal certain salient features of this culture (Agrawal, 1966). We have several dates for the period ca. 2100–1100 B.C. If we include the extreme dates of samples TF-573, 2905 ± 100 , and BM-54, 4250 ± 155 (Barker and Mackey, 1960), the maximum time spread for this Neolithic Culture can be bracketed within

ca. 2300–900 B.C. The three Hallur samples (TF-570, –573, –575) date the overlap phase with iron using megalithic people. This shows that for about 1,400 years the neolithic economy continued without any drastic change, although slow changes are perceptible. Whereas early neolithic at Piklihal (Allchin, 1960) and Utnur (Allchin, 1961) is completely free of any metal, copper artifacts are associated with the earliest neolithic phase at Tekklakota (Nagaraj Rao, 1965). The rusticated A₁ ware, which is an upper neolithic trait, occurs in Phase I at Tekklakota. A detailed comparative study of the wares of all the excavated sites would undoubtedly reveal the slow evolution even in neolithic pattern of life. In later sites more specialisation in society and trade should be discernible in the cultural assemblage.

If one plots the sites (with their C¹⁴ dates) latitudinally, there is a faint indication of a migratory pattern from north to south, as suspected by Sankalia also. This can be confirmed only by a larger number of measurements and more precise data about the cultural horizons of the samples.

Very interesting—though only three so far—are the dates for the end of the neolithic and the beginning of megalithic. Iron and Black-and-Red ware using megalithic folks are appearing in the South with the beginning of the first millennium B.C. Is it a migration to or from the Doab in view of very early megalithic there—in case the two are connected. The relation between the pre-P.G. Ware black-and-red ware and the pre-Iron Megaliths of Doab is worth pursuing.

ACKNOWLEDGEMENTS

Thanks are due to Shri K. K. Sivasankar for executing our designs of glass assembly very efficiently and to Shri P. S. Daudkhane for skilful assistance.

* C¹⁴ dates based on $\tau_{1/2} = 5730$ years have been used for discussion.

C¹⁴ DATES WITH SAMPLE DESCRIPTIONS**Bainapalli, Madras, India**

Bainapalli (Lat. 12° 33' N., Long. 78° 27' E.), District North Arcot, is a megalithic-neolithic site of the South. It was excavated by S. R. Rao. Samples submitted by A. Ghosh.

TF-350, *Megalithic Period* (?), 2265 ± 100
(2330 ± 105)

Charred grain from Trench BNP1, Locus C1, Pit 4, Sealed by Layer 3, Depth 1.30 m., Field No. BNP1/C1/64-2. Visible rootlets were handpicked. Comment: sample belongs to the end of megalithic period or is slightly later. Data given are not clear, though data expected by the excavator is ca. 300 B.C.

TF-349, *Neolithic Period*, 3340 ± 100
(3435 ± 100)

Charcoal from Trench BNP1, Locus A1, Layer 6, Depth 1.80 m., Field No. BNP1/A1/64-1. NaOH pretreatment was also given.

T. Narasipur, Mysore, India

T. Narasipur (Lat. 12° 13' N., Long. 76° 55' E.), District Mysore, was excavated by M. Seshadri, who submitted the samples.

TF-414, *Megalithic* (?), 220 ± 90
(225 ± 90)

Charcoal from T.N. 24 A, Locus C-D, Layer 3 A, Depth 0.67 m., Sample No. 3, 1965. Visible rootlets were handpicked. Comment: sample is much younger than expected.

TF-413, *Neolithic*, 3345 ± 105
(3445 ± 110)

Charcoal from T.N. 24 A, Locus C-D, Pit IV, Sealed by Layer 6 (?), Depth 1.77 m., Sample No. 2, 1965.

TF-412, *Neolithic*, 3645 ± 105
(3755 ± 110)

Charcoal from T.N. 24 A, Locus A-B, Layer 6, Depth 1.6 m., Sample No. 1, 1965. NaOH pretreatment was also given.

Sangankallu, Mysore, India

Sangankallu (Lat. 15° 11' N., Long. 76° 58' E.), District Bellary, was excavated originally by the late Subba Rao. Excavations were resumed recently by H. D. Sankalia who submitted the samples.

TF-354, *Neolithic Period*, 3440 ± 105
(3540 ± 110)

Charcoal from Trench 1-2, Layer 3, Depth 2.5 m., Field No. SKL/Tr. 1-2/64-65/393. NaOH pretreatment was also given. Comment: sample belongs to an early level.

TF-359, *Neolithic Period*, 3400 ± 100
(3500 ± 105)

Charcoal from Trench 1-2, Layer 4, Depth

2.4 m., Field No. SKL/Tr. 1-2/64-65/588. Visible rootlets were handpicked. NaOH pretreatment was also given. Comment: sample comes from an early level.

TF-355, *Neolithic Period*, 3435 ± 100
(3535 ± 105)

Charcoal from Trench S. Rao's II, Layer 2, Depth 1.40 m., Field No. SKL/S. Rao's II/64-65/474 (Eastern Section). Visible rootlets were handpicked. NaOH pretreatment was also given.

Hallur, Mysore, India

Hallur (Lat. 14° 20' N., Long. 75° 37' E.), District Dharwar, has recently been excavated by M. S. Nagaraj Rao. It gives a good sequence from neolithic to megalithic phases.

TF-580, *Early Neolithic Period*, 3560 ± 105
(3660 ± 105)

Charcoal from Trench 1, Layer 14, Depth 6.1-6.4 m., Sample No. 11, Field No. HLR/1965. Visible rootlets were handpicked. NaOH pretreatment was also given.

TF-575, *Late Neolithic Period*, 2895 ± 100
(2980 ± 105)

Charcoal from Trench-1, Layer 7, Depth 3.2 m., Sample No. 6, Field No. HLR/1965. NaOH pretreatment was also given. Comment (M. S. N.): sample derives from the latest neolithic phase just prior to the arrival of megalithic people.

TF-573, *Overlap Phase*, 2820 ± 100
(2905 ± 100)

Charcoal from Trench 1, Layer 5, Depth 2.35-3.55 m., Sample No. 4, Field No. HLR/1965. NaOH pretreatment was also given. Comment: sample belongs to Megalithic-Neolithic phase.

TF-570, *Overlap Phase*, 2970 ± 105
(3055 ± 105)

Charcoal from Trench-1, Layer 4, Depth 1.80-2.10 m., Sample No. 1, Field No. HLR/1965. NaOH pretreatment was also given. Comment: sample belongs to Megalithic-Neolithic overlap phase.

1. Agrawal, D. P., Kusumgar, S. and Sarna, R. P., *Curr. Sci.*, 1964, **33**, 266.
2. —, — and Lal, D., *Ibid.*, 1965, **34**, 394.
3. —, *New Light on the Neolithic-Megalithic Cultures* (in preparation).
4. Allchin, F. R., *Piklhal Excavations*, The Government of Andhra Pradesh, Hyderabad, 1960.
5. —, *Utnur Excavations*, The Government of Andhra Pradesh, Hyderabad, 1961.
6. Birker, H. and Mackey, C. J., *Radiocarbon Supplement*, 1960, **2**, 26.
7. Kusumgar, S., Lal, D. and Sharma, V. K., *Proc. Ind. Acad. Sci.*, 1963, **58**, 125.
8. Nagaraj Rao, M. S., *The Stone Age Hill Dwellers of Tekkalakota*, Deccan College, Poona, 1965.

HAEMOLYMPH PROTEINS AND REPRODUCTION IN *PERIPLANETA AMERICANA**

K. G. ADIYODI AND K. K. NAYAR

Department of Zoology, University of Kerala, Trivandrum-7

INVESTIGATION of the haemolymph proteins of the larva and adult of the cockroach *Periplaneta americana* by paper electrophoresis and starch gel electrophoresis has been attempted by several investigators, and it has been found that the pattern changes with the stages in development and moulting (see Wyatt¹ for review). Menon^{2,3} studied by paper electrophoresis the pattern of haemolymph proteins in adult females and recognized four distinct negatively charged fractions. She found that the allatum initiates oocyte growth by making available to the oocytes serum proteins especially the negatively charged fraction 2.

The haemolymph from newly emerged adult females, and the haemolymph, ovary, left colleterial glands and fat bodies of regular laying adult females and starved females were analyzed by disc electrophoresis in the manner described by Reisfeld *et al.*,⁴ to study the pattern of distribution of proteins in the cockroach in relation to the ovarian cycle and to assess the role of the allata in the production and/or mobilization of the soluble type of proteins. For purpose of comparison the electrophoretic pattern of the blood of normal male and allatectomized and virgin females was also studied.

Haemolymph was collected from animals by making a small puncture on the membrane connecting the coxa of the first leg with the body. The ovary, fat bodies, and colleterials were carefully washed in minute quantities of glass distilled water and homogenised. Haemolymph and the tissue fluids were centrifuged before spotting. The electrophoresis was run in a Canalco model 6 Disc Electrophoretic Unit on polyacrylamide gel for 25 m. using β alanine acetate as the buffer at pH 4.5.

In adult female *Periplaneta* approximately nine different protein fractions could be detected. The fractions have been numbered here from the 'origin' to the 'front'. The females in general showed a higher concentration of haemolymph proteins than males judged from the intensity of the stained bands. Two slow moving proteins, represented by fractions 3 and 4, appear to be the major components in the

blood in newly emerged and adult males and females, but in males fraction 4 occurs only in comparatively low amounts. The other fractions are variable. Fraction 4 appears to be synthesized under the influence of the corpus allatum and its concentration shows fluctuations which may be clearly correlated with the reproductive cycle. When the oocytes are fast growing this fraction is present only in medium amounts, and by the time the oocytes have reached their maximum size it becomes weak. During the period of ovulation and ootheca protrusion, there is an increase in the amount of this fraction, and in cockroaches with ootheca fully protruded, the accumulation of this fraction reaches its maximum. In allatectomized females there is a marked increase in the amount of haemolymph compared to the normal females. Some accumulation occurs in the protein fraction 4 following allatectomy, and this may be probably because of the protein formed under the influence of the allatum hormone already present. By about a month this fraction becomes weak; fraction 5 becomes strong in these animals, whereas the other fractions disappear. In just emerged adult females there is much less haemolymph compared to the adult female. In just emerged adult females, virgin females, and in adult females starved for a considerably long period fraction 4 occurs only in small concentrations, in some cases much less than in males (Fig. 1).

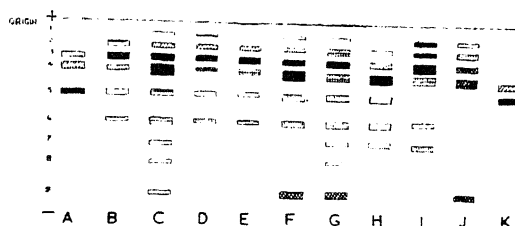


FIG. 1. Haemolymph proteins of *Periplaneta*. A. Normal adult female with basal oocytes 2.64 mm. (eggs are usually laid when they reach an average length of 3.84 mm.). B. Normal adult female with basal oocytes in the range 3.6 mm.-3.84 mm. C. Normal adult female with ootheca fully protruded. D. Normal adult male. E. Just emerged female. F. Just emerged adult female starved for 10 days. G. Just emerged adult female, fed and kept as virgin, sacrificed on the 9th day. H. Adult female starved for 2 weeks. I. Starved adult female with resorbing ovaries. J. Adult female starved for 3 weeks. K. Allatectomized adult female sacrificed after a month.

* The research work has been supported by a generous grant from the Ford Foundation.

In young adult females starved from the time of their emergence and sacrificed on the 10th day there is accumulation in fraction 4. Regular laying adult females subjected to starvation for 2-2½ weeks showed a similar general retention of fraction 4 and a corresponding decrease in the amount of fraction 3. Accumulation of fraction 4 may be taken as due to its non-utilization for oocyte growth under conditions of inanition whereas the paucity of fraction 3 may be related to the selective utilization of this fraction for maintenance during starvation. In starved females as time progresses and when the ovary undergoes resorption the accumulated fraction 4 becomes depleted, and there is a corresponding increase in fraction 3, suggestive of a conversion of fraction 4 to fraction 3 probably in an attempt to restore the deteriorating basic functions of the body.

In newly emerged females maintained as virgins or starved right from the time of their emergence and in starved adult females a 'front' fraction (fraction 9) becomes conspicuous. In normal males and females no such phenomenon has been observed.

Ovary with full-grown oocytes shows four protein fractions, 3, 4, 6 and 9, all common to the corresponding fractions in blood. The most conspicuous one is fraction 9, 6 being in traces. This suggests a probability that haemolymph proteins may pass into the ovary. Fractions 3 and 4, however, occur only as mild bands compared to blood. In the ovary of females starved for a long time and with vitellogenesis nearly completely inhibited fractions 3 and 4 fail to appear, fraction 9 alone being present. This may be taken as indicating that the relatively slow moving fractions 3 and 4 represent the "yolk proteins" in the oocytes of the cockroach. In spite of the accumulation in fraction 4 during the initial periods and fraction 3 at a later stage in the blood of starved females, these fractions fail to appear in their ovaries, and only fraction 9 occurs in moderate concentrations. This is consistent with the view that corpus allatum provides a mobilizing hormone making available serum proteins to the oocytes (Highnam *et al.*⁵); the failure of the ovary to incorporate yolk proteins in starved adult

females may be due to the low titre of the allatal hormone in blood.

The fat bodies of males, females with nearly full-grown oocytes, females with ootheca fully protruded, and females starved for 33 days showed only fraction 9 in nearly the same concentrations.

The secretion of the left colleterial glands has been seen to consist of four protein fractions, the most conspicuous ones being fractions 4 and 5. There are thus two fractions common to the left colleterial gland and ovary, *viz.*, fractions 4 and 9. These glands in the starved females show, like their ovary, only one band corresponding to fraction 9 (Fig. 2).

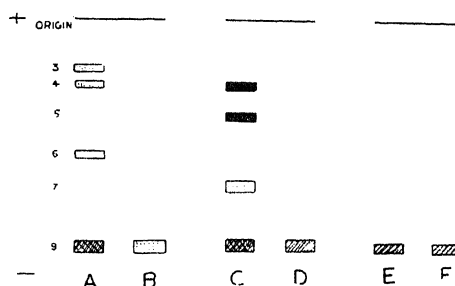


FIG. 2. A. Ovary of a normal adult female nearing oviposition (basal oocytes: 3.70 mm.). B. Spent ovary of an adult female starved for 2 weeks. C. Left colleterial of an adult female about to oviposit (basal oocyte: 3.84 mm.). D. Left colleterial of a starved adult female. E. Fat bodies of a normal female with basal oocytes 3.26 mm. F. Fat bodies of an adult female starved for 33 days.

The evidence presented here thus seems to suggest that the corpus allatum influences not only the synthesis of proteins especially fraction 4, but also that it takes part in the mobilization of this and other fractions like 3 and 6 to the ovary, and 5 and 7 to the colleterials for utilization.

1. Wyatt, G. R., *Ann. Rev. Ent.*, 1961, **6**, 75.
2. Menon, M., *Proc. XVI Internat. Cong. Zool.*, 1963, **1**, 297.
3. —, *J. Anim. Morph. Physiol.*, 1965, **12**, 76.
4. Reisfeld, R. A., Leuix, V. J. and Williams, D. E., *Nature*, 1962, **195**, 281.
5. Highnam, K. C., Iasis, O. and Hill, I., *J. inst. Physiol.*, 1963, **9**, 587.

LETTERS TO THE EDITOR

SPHERICALLY SYMMETRIC SPACE-TIMES AND PETROV'S CLASSIFICATION

IN the invariant theory of gravitational radiation the Riemann curvature tensor plays the central part. An algebraic classification of vacuum Riemann curvature tensors was carried out by Petrov.^{2,3} Since Weyl's conformal curvature tensor, given by Eisenhart¹

$$C_{abcd} = R_{abcd} + \left(\frac{1}{2}\right) (g_{ac}R_{bd} + g_{bd}R_{ac} - g_{ad}R_{bc} - g_{bc}R_{ad}) + \left(\frac{1}{6}\right) R (g_{ad}g_{bc} - g_{ac}g_{bd}), \quad (1)$$

possesses all symmetry properties of the Riemann tensor, for non-empty gravitational fields, the algebraic classification of Weyl's conformal curvature tensor can be carried out exactly as in the case of vacuum Riemann tensor. The purpose of the present note is to show that the Weyl conformal curvature tensor of the most general spherically symmetric space-time is of type D.

The most general spherically symmetric metric may be expressed as

$$ds^2 = e^A dr^2 + e^B (d\theta^2 + \sin^2\theta d\phi^2) - e^C dt^2, \quad (2)$$

where A, B and C are functions of r and t only.

With the help of the expressions for the Riemann curvature tensor and Ricci tensor, for the metric (2), given by Synge,⁵ the non-vanishing components of the Weyl conformal curvature tensor (1) are

$$\begin{aligned} C_{2323} &= (1/12) \sin^2\theta e^{2B} (e^{-A} \alpha + e^{-C} \beta) \\ &\quad + \left(\frac{1}{3}\right) \sin^2\theta e^B, \\ C_{1212} &= - (1/24) e^B (\alpha + e^{A-C} \beta) - \left(\frac{1}{6}\right) e^A, \\ C_{3131} &= \sin^2\theta C_{1212}, \\ C_{1414} &= - (1/12) (e^C \alpha + e^A \beta) - \left(\frac{1}{6}\right) e^{A-B+C}, \\ C_{2424} &= (1/24) e^B (e^{C-A} \alpha + \beta) + \left(\frac{1}{6}\right) e^C, \\ C_{3434} &= \sin^2\theta C_{2424}, \end{aligned}$$

where

$$\begin{aligned} \alpha &= 2B_{11} - 2C_{11} - C_1^2 - A_1B_1 + B_1C_1 + C_1A_1, \\ \beta &= 2A_{44} - 2B_{44} + A_4^2 - A_4B_4 + B_4C_4 - C_4A_4. \end{aligned}$$

The subscripts 1 and 4 after A, B and C represent partial differentiation with respect to r and t respectively.

Now following Pirani's⁴ scheme, the physical components of the Weyl tensor with the tetrad

$$\begin{aligned} l_{(1)}^i &= (e^{-A/2}, 0, 0, 0), \\ l_{(2)}^i &= (0, e^{-B/2}, 0, 0), \\ l_{(3)}^i &= (0, 0, (1/\sin\theta) e^{-B/2}, 0), \\ l_{(4)}^i &= (0, 0, 0, e^{-C/2}), \end{aligned}$$

can be written as

$$C_{PQ} = \begin{bmatrix} \epsilon & 0 & 0 & 0 & 0 & 0 \\ 0 & -\epsilon/2 & 0 & 0 & 0 & 0 \\ 0 & 0 & -\epsilon/2 & 0 & 0 & 0 \\ 0 & 0 & 0 & -\epsilon & 0 & 0 \\ 0 & 0 & 0 & 0 & \epsilon/2 & 0 \\ 0 & 0 & 0 & 0 & 0 & \epsilon/2 \end{bmatrix}, \quad (P, Q=1, \dots, 6)$$

where $\epsilon = (1/12) (e^{-A} \alpha + e^{-C} \beta) + (1/3) e^{-B}$. Therefore, we conclude that the most general spherically symmetric non-empty space-time is of type D.

Department of Mathematics, J. KRISHNA RAO.
Sardar Patel University,
Vallabh Vidyanagar,
Gujarat, September 1, 1966.

1. Eisenhart, L. P., *Riemannian Geometry*, Princeton University Press, 1926, p. 90.
2. Petrov, A. Z., *Sci. Not. Kazan State University*, 1954, 114, 55.
3. —, *Dissertation*, Moscow State University, 1957.
4. Pirani, F. A. E., *Phys. Rev.*, 1957, 105, 1089.
5. Synge, J. L., *Relativity: The General Theory*, North Holland Pub. Co., 1960, p. 270.

ANION-CATION COLLISION DIAMETERS OF MOLTEN SALTS

STILLINGER,¹ treating the ion core forces as those acting between rigid spheres, has shown that the distance of closest approach for an anion-cation pair can be predicted from the experimentally determined compressibilities. His results may be expressed in the form,

$$\rho k T \beta_T = \frac{(1-Y)^4}{(1+2Y)^2} \quad (1)$$

where

$$Y = \frac{\pi \rho a^3}{6}$$

or

$$a = \left(\frac{6Y}{\pi \rho} \right)^{1/3} \quad (2)$$

ρ denotes the number density of particles in the fluid, k is Boltzmann's constant, T is absolute

temperature, β_r is the isothermal compressibility and 'a' is the distance of closest approach. If, for a given fused salt observed at temperature T, measured values of the total ion number density and the isothermal compressibility are respectively substituted for ρ and β_r in relation (1), it is subsequently possible to assign a unique value of 'Y' to this melt. This deduced value of 'Y' along with the already used value ρ of the total ion number density, allows the corresponding distance of closest anion-cation approach to be obtained.

The isothermal compressibilities for a number of molten electrolytes are determined² by measuring ultrasonic velocities over a range of temperature above the melting point, by phase interference pulse technique, which can be used up to 800° C. Using these values of isothermal compressibilities the anion-cation distances of closest approach are computed from equations (1) and (2), and the results are presented in Table I along with the corresponding sums of Pauling ionic crystal radii.³ As can be seen from this table the computed distances are less than the crystal values. In a crystal the anion-cation separation corresponds roughly to the minimum position of the potential curve. In the liquid state at higher temperature where the ions are subjected to thermal agitation, the minimum anion-cation separation falls in the repulsive portion of the potential curve and as such the separation in this case is less compared to that in a crystal as the ion cores are not completely rigid but permit a certain degree of core interpenetration. Further it can be expected that the higher the temperature and the more the thermal velocities, the closer will be the distance of approach between anions and cations, a feature which can be seen from the data presented in Table I. The computed

distances for chlorides, bromides and iodides of the same metallic ions, retain the correct increasing order which is perhaps the most significant result of this investigation.

The author wishes to acknowledge his thanks to the Council of Scientific and Industrial Research, New Delhi, for awarding a Senior Research Fellowship.

Ultrasonic Research Lab.,
Department of Physics,
Andhra University,
Waltair (A.P.), October 5, 1966.

T. VEERARAJAH.

1. Stillinger, F. H., *J. Chem. Phys.*, 1961, **35**, 1581.
2. To be published.
3. Pauling, L., *The Nature of the Chemical Bond*, Cornell University Press, Ithaca, New York.

ELECTROLYTIC LABELLING WITH IODINE-131

I. Some Fluorescein, Phthalein and Diazo Dyes

IODINE-131 labelled fluorescein, phthalein and diazo dyes such as Rose Bengal (tetrachloro-P-tetraiodo-R-fluorescein) diiodo-fluorescein, bromsulfalein (phenol tetrabromphthalein disulphonate), tetra-iodo phenol phthalein, Evans Blue, and Congo Red have been used in medicine.¹⁻³ Methods described for the preparation of these labelled compounds involve exchange or iodination of the inactive compounds, using iodine-131 in the form of iodide, elemental iodine or iodine monochloride, at elevated temperatures (80–100° C.).⁴⁻⁶ The author found that labelling under these conditions is likely to affect the radiochemical purity of some of the higher halogenated fluoresceins.⁷ A method of labelling at lower temperatures, using active iodine liberated during electrolysis of sodium iodide solution has been studied here for labelling these derivatives. This method gives good yields and labelled products of high radiochemical purity. The details of the method are given below.

50–100 mg. of the compound to be labelled is dissolved in dilute sodium hydroxide solution and the pH of the solution is adjusted to approximately 6–8. The required quantity of carrier-free sodium iodide-I-131 (pH 8–9, sulphite, thiosulphate and preservative-free) is added and the solution electrolysed at 1–2 milli-amperes (2–6 volts), using platinum electrodes, the mixture being kept stirred well at 30–60° C. At the end of 3–6 hours, the labelled derivative is separated out by precipitation (in the case of Rose Bengal, iodo-fluorescein, etc.) or by column chromatography in the case of bromsulfalein.⁸ A yield of

TABLE I

Values of the anion-cation collision diameters computed from the isothermal compressibilities

Salt	Sum of crystal radii Å	Temperature ° C.				
		400	500	600	700	800
		Å	Å	Å	Å	Å
AgCl ..	2.77	..	2.68	2.64	..	..
AgBr ..	2.93	..	2.78	2.75	..	..
CdCl ₂ ..	2.78	..	..	2.47	2.45	2.39
CdBr ₂ ..	2.92	..	..	2.63	2.57	..
CdI ₂ ..	3.13	..	4.12	..	..	..
PtCl ₂ ..	2.98	..	..	2.77	2.70	..
PbBr ₂ ..	3.14	..	3.01	2.93	..	..
ZnCl ₂ ..	2.55	2.40	2.38	..	..	..
ZnBr ₂ ..	2.69	2.61	2.52	..	..	..

30-60% has been obtained. The radiochemical purity of the labelled products has been ascertained by paper chromatography as follows:

- (a) I-131: Rose Bengal—Ascending paper chromatography using 0.56% aqueous ammonia as solvent. R_f of tetrachloro-P-tetraiodo-fluorescein 0.5-0.6. R_f of iodide approximately 0.8 (R_f of other iodochloro-fluoresceins varies from 0.2 to 0.8).
- (b) Iodine-131 labelled iodofluoresceins—Ascending paper chromatography using dilute HCl solution as solvent. R_f of iodofluoresceins 0, R_f of iodide approximately 0.8.
- (c) Iodine-131 labelled BSP—Ascending chromatography using butanol-acetic acid-water (1.48 : 0.37 : 1) as solvent; R_f of BSP—0.6, R_f of iodide 0.3.
- (d) Iodine-131 labelled Evans Blue—Paper electrophoresis in dilute phosphate buffer solution (Iodide migrate ahead of Evans Blue).

Isotope Division,
Atomic Energy Establishment,
Trombay, April 25, 1966.

R. S. MANI.

1. Taplin, G. V., Meredith, O. M. and Kadi, H., *J. Lab. and Clin. Med.*, 1955, **45**, 665.
2. Tubis, M., Nordyke, R. A., Posnick, E. and Bhahd, W. H., *J. Nucl. Med.*, 1961, **2**, 282.
3. Fields, T. and Seed, L., "Clinical uses of radio isotopes," *A Manual of Techniques*, The Year Publishers, Inc., New York, 1961.
4. Liebster, J. Andrysek, *Nature*, 1959, **184**, 913.
5. Tubis, M. and Posnick, E., *Proc. Society Exptl. Biology and Med.*, 1960, **103**, 497.
6. Mitta, A. and Farga, L., *Int. Jour. Appl. Radn. and Isotopes*, 1961, **12**, 146.
7. Mani, R. S. (To be published).
8. —, *Indian J. Chem.* (In press).

Br⁷⁹ ZEEMAN EFFECT AND CRYSTAL STRUCTURE OF p-BROMOACETOPHENONE

IN continuation of the work on Zeeman effect of Bromine Nuclear Quadrupole Resonance,¹ results obtained from a preliminary analysis of the Zeeman effect of Br⁷⁹ in p-bromoacetophenone are presented in this note. The resonance frequency of Br⁸¹ in this compound was first reported by Bray² as 230-670 Mc./sec. at liquid nitrogen temperature. Subsequently Br⁷⁹ resonance was observed at 271.46 Mc./sec. at room temperature by Rama Rao, Nagarajan and Murty.³ In the present work the Zeeman effect was investigated at room temperature using

conventional Lecher line super-regenerative oscillator and Helmholtz coil type magnet.

The single crystals used in the experiment were grown from melt in the form of large cylinders. No crystal data are available for this compound. The crystal was rotated about the growth axis (axis of the cylindrical crystal) and two other mutually perpendicular axes to the growth axis. In the growth axis rotation and a perpendicular axis rotation, a single zero splitting locus was observed. We could not observe the zero splitting locus about the third axis of rotation due to small angle between the field gradient z and the axis of rotation.

Our results indicate the presence of only a single field gradient system in this compound. The asymmetry parameter η of the field gradient was obtained by least square refinement of the zero-splitting loci and is given below together with θ_z and ϕ_z of the field gradient z with respect to the laboratory system of co-ordinates.

	θ_z	ϕ_z	η
Parallel to growth axis	112° 9'	60° 14'	0.08
Perpendicular to growth axis	115° 33'	62° 1'	0.07

From the preliminary optical study we found that the crystal belongs to either triclinic, monoclinic or orthorhombic. Since θ_z of the field gradient with respect to the growth axis is 112° 9' we could rule out the orthorhombic class. From Shimamura's⁴ calculations we could also say that the crystal may be triclinic or monoclinic. If it is monoclinic the field gradient z should lie in the 'ac' plane and the growth axis may be 'a' or 'c'.

We also calculated the bond characters of the C-Br bond taking the asymmetry parameter as 0.07 ± 0.02 and obtained 81.1% for the single bond, 2.6% for the double bond and an ionic character of 16.3%.

We are grateful to Prof. K. R. Rao for his kind interest and encouragement and one of us (K. K. R.) is grateful to CSIR for the award of a Fellowship.

Magnetic Resonance Lab., K. KAMESWARA RAO.
Physics Department, C. R. K. MURTY.
Andhra University,
Waltair, October 4, 1966.

1. Rama Rao, K. V. S. and Murty, C. R. K., *Curr. Sci.*, 1965, **34**, 660; *Ibid.*, 1966, **35**, 252; *J. Phys. Soc., Japan*, 1966, **21**, 1627.
2. Bray, P. J., *J. Chem. Phys.*, 1954, **22**, 950.
3. Rama Rao, K. V. S., Nagarajan, V. and Murty, C. R. K., *Curr. Sci.*, 1965, **34**, 128.
4. Shimamura, K., *J. Phys. Soc., Japan*, 1957, **12**, 652.

DISLOCATION PILE-UPS IN ANTIMONY SINGLE CRYSTALS

It is well known that dislocations move under stress and when the motion of dislocations in a slip plane is obstructed by an obstacle which may or may not be in a slip plane, pile-up is observed. The final arrangement of these dislocations in a pile-up is such that the forces on them from the applied stress, the obstacle and their mutual interaction are in equilibrium.^{1,2} Assuming such an equilibrium and that dislocations are parallel, the stress (σ_p) on the i -th dislocation in a pile-up is given by⁴

$$\sigma_p \propto \sum_{\substack{i=1 \\ i \neq j}}^n (x_i - x_j)^{-1} \quad (1)$$

A plot of the summation against x_i should be a straight line of zero slope. Young^{3,4} has made detailed study of the spacing of etch pits in pile-ups in copper single crystals and has shown that the spacings do not conform to the theoretical estimate. He has suggested that this may be due to the fact that the barrier may not be in the plane of observation and the negative result should not be considered as a failure of the theory. The dislocation spacing in pile-ups in the case of antimony single crystals has been presented here.

Single crystals of antimony were grown from melt in a horizontal furnace in an atmosphere of purified hydrogen in open graphite boats. The crystals were cleaved in the conventional way at the temperature of liquid air. The cleavage stress itself is found to cause plastic deformation in these crystals.

Etch method was adopted to reveal dislocations in the (111) planes of the crystals. Various reagents have been reported which reveal dislocations in antimony crystals. After numerous trials proper reagent was selected for revealing dislocations. A reagent consisting of 3 parts HF, 5 parts fuming HNO₃ and 3 parts glacial acetic acid was used to etch the crystals. The effectiveness of the reagents to reveal dislocations was established by (a) matching of the pits on the cleavage counter parts and (b) measuring the dislocation densities along the intersecting sub-boundaries.

Figure 1 shows a pile-up of dislocations in antimony crystal. The dislocation spacings were measured and the summation given in equation (1) is plotted in Fig. 2. The nature of the graph is similar to that obtained for copper by Young.⁴ Deviation from expected

spacing for a group of parallel dislocations under uniform external stress is observed in antimony crystals also.

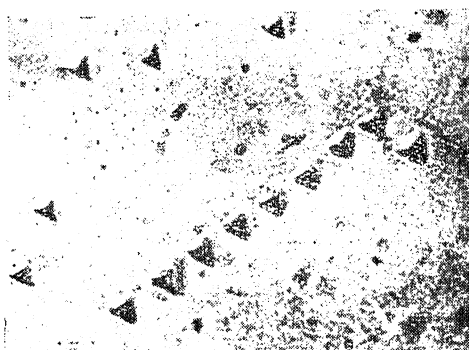


FIG. 1. $\times 575$.

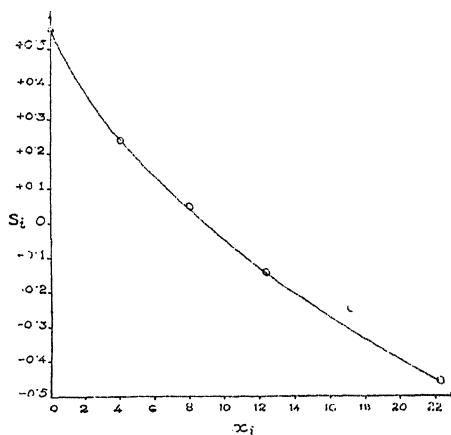


FIG. 2

The author is grateful to Prof. N. S. Pandya for his guidance. Thanks are also due to Dr. A. P. Balasubramanian for helpful discussions, and to the C.S.I.R., New Delhi, for the award of a Junior Research Fellowship.

Physics Department,
Faculty of Science,
M.S. University of Baroda,
Baroda, June 29, 1966.

B. B. THAKAR.

1. Cottrell, A. H., *Progress in Metal Physics*, Butterworth's Publications, Vol. 1, Ch. II.
2. —, *Dislocations and Plastic Flow in Crystals*, Clarendon Press, Oxford, p. 105.
3. Young, F. W. Jr., *Proceedings of International Conference on Lattice Defects*, Japan, 1964.
4. —, *J. Appl. Phys.*, 1962, **33**, 3553.

ROTATIONAL ANALYSIS OF D-X
SYSTEM OF $\text{Cu}^{63}\text{I}^{127}$ MOLECULE

THE spectrum of $\text{Cu}^{63}\text{I}^{127}$ molecule was studied by Mulliken¹ (1925) and Ritschl² (1927). Ritschl² recorded five extensive band systems all degraded to red in the region 3750–5500 Å. Nair and Upadhy³ (1966) analysed E-X and C-X systems showing $^1\Sigma^-1\Sigma$ type of transitions analogous to E-X and C-X systems of CuCl molecule analysed by Rao, Asundi and Brody⁴ (1962). In the present note we communicate results of analyses of 0, 1 and 0, 2 bands of D-X system of CuI molecule. The bands were excited in microwave discharge by Raytheon Oscillator (2450 Mc./sec.) and the rotational structure was photographed in the second order of 10 metre grating spectrograph in our laboratory. The overlapping structure due to the less abundant species $\text{Cu}^{65}\text{I}^{127}$ has been avoided by adjusting the time of exposure. Rotational analyses of 0, 1 and 0, 2 bands were carried out and rotational constants have been determined and are given in Table I.

TABLE I

Rotational constants of D-X systems

Upper State	Lower State
$B_0' = .0665 \text{ cm.}^{-1}$	$B_1'' = .0725 \text{ cm.}^{-1}$
$D_0' = 3.7 \times 10^{-8} \text{ cm.}^{-1}$	$B_2'' = .0720 \text{ cm.}^{-1}$
$r_0' = 2.54 \times 10^{-8} \text{ cm.}$	
$I_0' = 420.75 \times 10^{-40} \text{ gm. cm.}^2$	

The bands show R and Q heads in which R head is very weak. The transition is of type $^1\Pi-1\Sigma$. The procedure adopted is the same as suggested by Herzberg.⁵ The lower state constants obtained from the present analysis and that of E-X and C-X systems agree very well.

The B_1'' and B_2'' values for E-X system (1966) agree well with those given above. The constants for X-state have been given in detail in the paper by Nair and Upadhy³ (1966).

Department of Spectroscopy, K. P. R. NAIR.
College of Science, K. N. UPADHYA.
Banaras Hindu University,
Varanasi-5 (India), June 4, 1966.

FERROUS ALKOXIDES

THE alkoxides of trivalent iron have been reported earlier.^{1,2} As a result of our studies on the formation of such compounds when iron is in the oxidation state of +2, ferrous methoxide and ethoxide have been obtained by the action of dry ammonia on an alcoholic solution of ferrous chloride.

$\text{FeCl}_2 + 2\text{ROH} + 2\text{NH}_3 \rightarrow \text{Fe(OR)}_2 + 2\text{NH}_4\text{Cl}$.
The higher alkoxides could not be prepared by the ammonia method or alcohol interchange³ method due to the ready oxidation of the alkoxide during the course of the reaction.

Preparation of Ferrous Ethoxide.—Ferrous chloride (10 g.), dissolved in ethyl alcohol (50 g.) and benzene (120 g.), was treated with excess of dry ammonia. After the completion of this exothermic reaction, the excess of ammonia along with the solvents was removed under reduced pressure. The residue was extracted with benzene (200 g.) and filtered. The filtrate on evaporation under reduced pressure yielded a yellow solid, which on crystallisation from ethyl alcohol furnished ferrous ethoxide as a pale yellow crystalline substance [Found: Fe, 38.29; OEt, 61.62; Fe(OEt)_2 requires Fe, 38.29; OEt, 61.71%].

Ferrous methoxide was similarly prepared as a light pink crystalline solid [Found: Fe, 47.26; OMe, 51.98; Fe(OMe)_2 requires Fe, 47.4; OMe, 52.6%].

Anhydrous ferrous chloride required for the above preparation was prepared as a pearly crystalline solid by strongly heating iron powder in the presence of dry hydrogen chloride gas and replacing the residual hydrogen chloride by dry nitrogen.

The alkoxides described above get easily hydrolysed and the usual precautions⁴ were taken to exclude moisture. Iron in the alkoxide was determined gravimetrically as ferric oxide and the methoxide and ethoxide by the chromic acid method.⁵

The authors thank Prof. T. R. Seshadri, F.R.S., for helpful discussions.

Department of Chemistry, B. D. JAEN.
University of Delhi, R. K. MULTANI.
Delhi-7, October 5, 1966.

1. Mulliken, R. S., *Phys. Rev.*, 1925, 26, 1.
2. Ritschl, R., *Z. Physik.*, 1927, 42, 172.
3. Nair, K. P. R. and Upadhy, K. N., *Cand. J. Phys.*
4. Ramakoteswara Rao, P., Asundi, R. K. and Brody, J. K., *Ibid.*, 1962, 40, 423.
5. Herzberg, G., *Spectra of Diatomic Molecules*, D. Van Nostrand Co., Inc., N.Y., 1950.

1. Thiessen, P. A. and Keerner, O., *Z. Anorg. Chem.*, 1929, 65, 180.
2. Bradley, D. C., Multani, R. K. and Wardlaw, W., *J. Chem. Soc.*, 1958, p. 126.
3. —, — and —, *Ibid.*, 1958, p. 4153.
4. Multani, R. K., *Curr. Sci.*, 1964, p. 430.
5. Bradley, D. C., Multani, R. K. and Wardlaw, W., *J. Chem. Soc.*, 1958, p. 4647.

PRECIPITATION OF BARIUM SULPHATE FROM HOMOGENEOUS SOLUTION

THE precipitation of barium as barium sulphate utilising the technique of precipitation from homogeneous solution (PFHS) has been reported by a number of workers.¹⁻⁵ Sulphite ion⁶ has already been reported as a source reagent for sulphate ions in the precipitation of rare earth alkali double sulphates.

The present communication deals with the property of cation release coupled with the oxidation characteristics of hydrogen peroxide. The sulphite ion has been employed for the generation of sulphate ions.

Barium is complexed with ethylenediamine tetraacetic acid at pH 10.0 using ammonium chloride-ammonia buffer. A freshly prepared sodium sulphite solution is then introduced, followed by addition of hydrogen peroxide. The solution is heated on a hot plate when after half an hour first signs of turbidity appear. The digestion is continued for 2 hours during which period the whole of barium is precipitated and the filtrate contains no barium ions. The weights of the precipitates dried at 110° C. or ignited at 900° C. are fairly close to one another.

10-120 mg. of barium have been successfully estimated in the presence of large amount of calcium, magnesium, iron (III) and small amounts of lead. Strontium ions interfere seriously. Ammonium acetate has been used as a masking agent for lead ions.

The authors are thankful to Professor T. R. Seshadri, F.R.S., for his encouragement and to the Ministry of Education for the award of Research Fellowships to two of them (K. C. T. and D. P. G.).

Department of Chemistry,
University of Delhi,
Delhi-7, August 4, 1966.

D. P. GOEL.
R. P. SINGH.
K. C. TRIKHA.

1. Wagner, W. F. and Wuellner, J. A., *Anal. Chem.*, 1952, **24**, 1031.
2. Elwing, P. J. and Van Atta, R. D., *Ibid.*, 1950, **22**, 1375.
3. — and Zook, W. C., *Ibid.*, 1953, **25**, 502.
4. Heyn, A. H. A. and Shupak, E., *Ibid.*, 1954, **26**, 1243.
5. Freund, H., *Ph.D. Dissertation*, University of Michigan, 1945; Gordon, L., Salutsky, M. L. and Willard, H. H., *Precipitation from Homogeneous Solution*, John Wiley & Sons, Inc., N.Y., 1959, pp. 69, 73.
6. Vickery, R. C., *J. Chem. Soc.*, 1955, p. 2360.

DERIVATIVES OF 5-CHLORO-2-ALKYLQUINAZOLINONES

IN the course of our work on 3,4-dihydroquinazolin-4-ones,¹ we had occasion to synthesise the following 3-substituted 5-chloro-2-alkyl-3, 4-dihydroquinazolin-4-ones. The compounds reported in this communication were prepared by the action of the appropriate amines on the corresponding 4 H-3, 1-benzoxazin-4-ones. A few of the compounds reported here have been earlier prepared by Sumitomo Chemical Co.,² by reacting 6-chloro-N-acetyl-anthranilic acid with the required amine in presence of phosphorus trichloride.

A few typical experiments are described below.

2-Methyl-5-Chloro-4H-3, 1-Benzoxazin-4-one. 6-Chloro-N-acetyl-anthranilic acid (10 g.) and acetic anhydride (25 ml.) were refluxed for two hours. The excess of acetic anhydride and the acetic acid formed were distilled off *in vacuo*. The crude 2-methyl-5-chloro-4H-3, 1-benzoxazin-4-one thus obtained was crystallised from benzene-hexane; m.p. 142-43°.

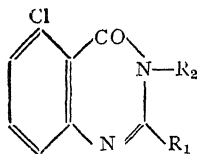
Found: N, 7.39; Calculated for $C_9H_6O_2NCl$: N, 7.16%.

2-Methyl-3-n-Propyl 5-Chloro-3, 4-Dihydroquinazolin-4-one. 2-Methyl-chloro-4H-3, 1-benzoxazin-4-one (2 g.) and n-propylamine (4 ml.) were refluxed for one hour. The resulting gummy mass was triturated with dilute hydrochloric acid to remove the excess of propylamine and then with dilute sodium hydroxide solution to obtain the crude title product. It was crystallised from aqueous ethanol; m.p. 194-95°. Found: N, 11.63; Calculated for $C_{12}H_{13}ON_2Cl$: N, 11.84%.

2-Ethyl-5-Chloro-4H-3, 1-Benzoxazin-4-one. 6-Chloro-N-propionylantronic acid (4 g.) and propionic acid anhydride (12 ml.) were refluxed for two hours. The excess of propionic acid anhydride and the propionic acid formed during the reaction were distilled off *in vacuo* to obtain 2-ethyl-5-chloro-4H-3, 1-benzoxazin-4-one. It was crystallised from benzene-hexane; m.p. 86-88°. Found: N, 6.94; Calculated for $C_{10}H_8O_2NCl$: N, 6.68%.

2-Ethyl 3-(N, N-Dimethylaminopropyl)-5-Chloro-3, 4-Dihydroquinazolin-4-one. 2-Ethyl-5-chloro-4H-3, 1-benzoxazin-4-one (2 g.) and dimethylaminopropylamine (3 ml.) were refluxed in dry benzene (30 ml.) for six hours. The resulting benzene solution was washed with dilute sodium hydroxide solution and then with water. It was then concentrated to half of its volume and diluted with hexane to obtain the title product. It was crystallised from benzene-

TABLE I



No.	R ₁	R ₂	m.p. °C.	Lit. m.p. °C.	Nitrogen %	
					Found	Calculated
I	CH ₃	—CH ₂ CH ₂ CH ₃	194–95	..	11.63	11.84
II	CH ₃	—CH ₂ CH ₂ CH ₂ CH ₃	176–78	..	10.96	11.18
III	CH ₃	—CH ₂ CH ₂ OC ₂ H ₅	150–51	..	10.27	10.51
IV	CH ₃	—CH ₂ CH ₂ CH ₂ OCH ₃	137	..	10.38	10.51
V	CH ₃	—CH ₂ CH ₂ CH ₂ N(CH ₃) ₂	136–38	..	14.78	15.03
VI	CH ₃	—CH ₂ CH ₂ CH ₂ N(CH ₂ CH ₂) ₂ O	139–41	..	12.89	13.06
VII	CH ₃	—C ₆ H ₃ (CH ₃)Cl(2-3)	147–49	146–47 ²	8.86	8.78
VIII	CH ₃	—CH ₂ CH ₂ —	155–56	..	13.85	14.03
IX	CH ₃	—CH ₂ CH ₂ C ₆ H ₅	151–53	..	9.54	9.38
X	CH ₃	—C ₆ H ₅	144–45	141–42 ²	9.97	10.35
XI	CH ₃	—C ₆ H ₄ OCH ₃ (4)	145–47	..	9.52	9.32
XII	CH ₃	—C ₆ H ₄ Cl (3)	173–75	176–79 ²	8.92	9.18
XIII	C ₂ H ₅	—C ₆ H ₄ OCH ₃ (3)	164–65	..	8.67	8.90
XIV	C ₂ H ₅	—C ₆ H ₄ CH ₃ (2):H ₂ O	172–74	..	8.86	8.85
XV	C ₂ H ₅	—CH ₂ CH ₂ —C ₆ H ₅	164–66	..	8.76	8.96
XVI	C ₂ H ₅	—CH ₂ C ₆ H ₅	172	..	9.16	9.38
XVII	C ₂ H ₅	—CH ₂ CH ₂ CH ₂ N(CH ₃) ₂	132–33	..	14.04	14.31
XVIII	C ₂ H ₅	—CH ₂ CH ₂ —	132–34	..	13.68	13.40

hexane m.p. 132–33°. Found: N, 14.04; Calculated for C₁₅H₂₀ON₃Cl: N, 14.31%.

Scientific and Technical S. SOMASEKHARA.
Research Division, V. S. DIGHE.
Sarabhai Chemicals, S. L. MUKHERJEE.
Baroda, July 1, 1966.

1. Somasekhara, S., Dighe, V. S. and Mukherjee, S. L., *Indian J. of Pharmacy*, 1965, **27**, 12.
2. Yamamoto, H., Sakai, S. and Maruyama, I., *Japanese Pat. No. 13, 749*; Sumitomo Chemical Co., 1965; *C.A.*, 1965, **63**, 11585.

PAPER CHROMATOGRAPHIC STUDIES OF THIAZOLES AND THIAZOLINES

DURING our recent investigation on the synthesis of thiazoles and thiazolines, a new condensing agent bromine was tested if it could replace the conventional use of iodine¹⁻³ in the synthesis of 2-arylamino thiazoles and 2-arylimino thiazolines from various ketones and mono and diaryl (Sym) thioureas respectively. During the course of synthesis, it was required to test if the final product contained any unreacted thioureas. Paper chromatography suggested itself as the method of choice for this purpose, provided a suitable method could be found out

to study the paper chromatographic behaviour of thiazoles, thiazolines, and mono and diaryl thioureas. As not much work has been done in this direction, we took up the problem to find out the conditions under which thiazoles, thiazolines and thioureas respond to the paper chromatographic separation.

n-Butanol, acetic acid and water (4:1:5) were selected as the most suitable mobile phase. One-dimensional descending chromatogram was run on Whatman No. 1 chromatographic paper. The attainment of equilibrium on the chromatographic system presented no problem unlike that of Kjaer and Rubinstein⁴ who used saturated chloroform as the mobile phase. The usual time of run was 18 hours. 0.01 c.c. of 0.4% solution of the substance in ethanol was used for each spot.

After development, the paper was taken out of the bath and was dried in air. The dried chromatogram was sprayed with different visualizing agents.

For monoaryl thioureas, Grote's reagent as well as Feigl's reagent were used. But Feigl's reagent proved better than Grote's reagent as opposed to the observation of Kjaer and Rubinstein.⁴ Twelve monoaryl thioureas were

TABLE I
 R_f values of the products

Time—18 hours.			Solvent— <i>n</i> -Butanol : acetic acid : water = 4 : 1 : 5		
Sl. No.	Name of the product	R_f value	Visualizing agent	Colour of the spot	
1	Monophenyl thiourea	.. .86	Feigl's reagent	Colourless spot on a bluish back-ground	
2	Thiocarbanilide	.. .94	Ammonical silver nitrate solution	Grey spot	
3	2-Amino 4-phenyl thiazole	.. .90	Diazotised sulphanilic acid	Orange red spot	
4	2-Phenylamino 4-phenyl thiazole	.95	do.	do.	
5	2-Phenylimino 3 : 4 diphenyl thiazoline	.93	Acidified KMnO_4	Colourless spot in a purple back-ground	

detected by Feigl's reagent, when colourless spots in a bluish background were obtained. Nitrophenyl thioureas do not require any visualizing agent as they are coloured yellow and give yellow-coloured spots on dried chromatogram.

2-Amino thiazoles and 2-arylamino thiazoles having 5-position free were detected by spraying the dried chromatogram lightly first with 5% aqueous sodium carbonate and then, while the paper was still damp, with diazonium spray⁵ (25 c.c. of freshly prepared 5% sodium nitrite is slowly added at 0° C. to 5 c.c. of a sulphanilic acid plus 9 c.c. of concentrated HCl, diluted to 100 c.c. with distilled water). 2-Arylamino and 2-amino thiazoles appeared as orange red spots.

Sym-diaryl thioureas did not respond to either Grote's or Feigl's reagent satisfactorily, and were detected by spraying the dried chromatogram with ammoniacal silver nitrate⁶ (5 N NH_4OH : 0.1 N AgNO_3 V/V) solution when gray spots appeared immediately.

2-Arylimino thiazolines were detected by spraying the dried chromatogram with 0.5% solution of KMnO_4 acidified with H_2SO_4 ,⁷ when the spots appeared immediately as colourless in a purple background.

The R_f values obtained in each of the class of the compound were quite reproducible with not much of variation as experienced by Kjaer and co-worker. As the visualizing agents are specific in nature, it was very easy to detect whether thiazoles and thiazolines are respectively free from mono and diaryl thioureas. It is needless to mention that many of the thiazoles and thiazolines did not contain mono or diaryl thioureas, showing that the reaction went to completion with the new condensing agent. R_f values of a few products are given in Table I.

We thank the Board of Scientific and Industrial Research, Orissa, for a research grant to do the work.

Department of Chemistry, B. K. PATNAIK.
Ravenshaw College, B. C. DASH.
Utkal University, D. P. DAS.
Cuttack, July 8, 1966. G. N. MAHAPATRA.

1. King, L. C. and Hlavacek, R. J., *J. Amer. Chem. Soc.*, 1950, **72**, 3722.
2. Mahapatra, G. N. and Rout, M. K., *J. Ind. Chem. Soc.*, 1953, **30**, 398.
3. —, *J. & Proc. Inst. Chem.*, 1959, **31**, 113.
4. Kjaer, A. and Rubinstein, K., *Nature*, 1953, **171**, 840.
5. Ames, B. N. and Mitchell, H. K., *J. Amer. Chem. Soc.*, 1952, **74**, 252.
6. Hinman, R. L., *Anal. Chim. Acta*, 1956, **15**, 125.
7. Prochazka, Z., *Chem. Listy*, 1950, **44**, 43; *Chem. Abstr.*, 1951, **45**, 5561.

HISTOCHEMICAL STUDIES ON THE INTERRENAL TISSUE OF THE COMMON INDIAN MURREL, *OPHICEPHALUS PUNCTATUS*

In teleost, interrenal tissue around the posterior cardinal vein in the head kidney is homologous to the avian or mammalian adrenal cortex. Some reports are available concerning the histochemically demonstrable entities of the teleost interrenals. Thus, Krauter¹ showed the presence of black granular droplets in the gold fish interrenals by Sudan black. In addition to sudanophilic lipid, Chavin and Kovacevic² demonstrated cholesterol, glycogen and phospholipid in the same fish. They could detect the presence of ascorbic acid only when the fishes were asleep. In *Carassius auratus*, Mahon *et al.*³ traced interrenal ascorbic acid by the freeze-drying technique. The present study is based on some of the histochemical studies of the interrenal tissue of an Indian murrel, *Ophicephalus punctatus* (fam. Ophicephalidae). The different methods used and the findings have been incorporated in Table I.

A perusal of Table I reveals that the interrenal tissue contains abundance of sudanophilic lipids and acetal phosphatides. Whether these substances *in situ* represent site of biologically active ketonic steroid hormones is very much

TABLE I

Showing the histochemically demonstrable substances in the interrenal of *O. punctatus*

Tests	Interrenal parenchyma
Sudan black B method for total lipid (Carleton and Short ⁴)	++
Schultz method for cholesterol (Weber <i>et al.</i> ⁵)	-
Plasmal reaction (Hayes ⁶)	++
Method for neutral polysaccharides (Glegg <i>et al.</i> ⁷)	δ ⁺
Ascorbic Acid (Deane and Morse ⁸)	-
Method for metachromasia (Montagna <i>et al.</i> ⁹)	-
Method for alkaline phosphatase (Kurban and Affi ¹⁰)	π ⁺
Method for acid phosphatase (Gomori ¹¹)	π ⁺

++ Intense reaction ; δ⁺ Moderate reaction in basement membrane only ; π⁺ Moderate reaction in nucleus only ; - Negative.

debatable. Probably these lipoidal materials are hormone precursors. Deane and Seligman,¹² however, indicate that usually far more ketonic lipid occurs in steroid-producing organs than the proportion necessary for the production of biologically active hormones. Since cholesterol is believed to constitute the precursor of steroid hormones, the negative reaction in Schultz test for cholesterol is an interesting finding. Of course, a negative colour reaction may mean that Schultz test is not sufficiently sensitive to detect the amount of cholesterol present in the interrenal cells of the species concerned. Alternately a different pathway of corticoid synthesis not involving cholesterol is also plausible (cf. Dorfman¹³). A biochemical assessment is rather needed to know definitely whether interrenals of this fish contain some amount of cholesterol.

Cytochemically detectable ascorbic acid remains consistently absent from the interrenal of this ophicephalid. All our efforts to sacrifice the fishes in sleeping condition (as laid down by Chavin and Kovacevic²) proved to be entire failure. Whether the stress during sacrifice produces quick depletion of vitamin C is to be verified in a number of species.

PAS-reactive polysaccharides are present only in the basement membranes. Histo enzymic pattern of both alkaline and acidic phosphatases shows an almost negative cytoplasmic reaction while nuclear reaction is moderate. The phosphate bond energy derived by the nuclear phosphatase might constitute here the source of energy for corticoidogenesis (Gemzell¹⁴).

In conclusion, it may be stated that the histochemical findings of the interrenal of *O. punctatus* is not comparable in many respects to those of the mammals (cf. Chavin and Kovacevic²).

Histophysiology Laboratory, T. K. BANERJI.
Department of Zoology, ASOK GHOSH.
35, Ballygunge Circular Road,
Calcutta-19, June 3, 1966.

1. Krauter, D., *Wilhelm. Roux Arch. Entw. Mech. Org.*, 1958, **150**, 601.
2. Chavin, W. and Kovacevic, A., *Gen. Comp. Endocrinol.*, 1961, **1**, 264.
3. Mahon, E. F., Hoar, W. S. and Tabata, S., *Canad. J. Zool.*, 1962, **40**, 449.
4. Carleton, H. M. and Short, R. D. H., *Schaffer's Essentials of Histology*, Longmans, Green & Co., London.
5. Weber, A. F., Phillips, M. G. and Bell, J. T., *J. Histochem. Cytochem.*, 1956, **4**, 308.
6. Hayes, E. R., *Stain Tech.*, 1949, **24**, 19.
7. Glegg, R. E., Clermont, Y. and Leblond, C. P., *Ibid.*, 1952, **27**, 277.
8. Deane, H. W. and Morse, A., *Anat. Rec.*, 1948, **100**, 127.
9. Montagna W., Chase, H. B. and Melaragno, H. P., *J. Nat. Cancer Inst.*, 1951, p 12.
10. Kurban, A. K. and Affi, A. K., *Stain Tech.*, 1962, **37**, 7.
11. Gomori, G., *Histochemical histochemistry, Principles and Practice*, University of Chicago Press, Chicago., U.S.A., 1952.
12. Deane, H. W. and Seligman, A. M., In *Vitamins and Hormones*, Editors: R. S. Harris, G. F. Marriman and K. V. Thimann, Academic Press Inc., N.Y., 1953, **1**, 173.
13. Dorfman, R. I., *Comparative Endocrinology*, Ed. A. Gorbman, New York, 1959.
14. Gemzell, C. A., *Acta Endocrin. Suppl.*, 1948, p. 1.

OCCURRENCE OF THE NEMATODE *HOPLOLAIMUS INDICUS* IN W. BENGAL

THE survey of West Bengal, conducted by the authors during the years 1964-65, showed that, next to *Meloidogyne*, *Hoplolaimus* is probably the most widely distributed phytoparasitic nematode. The genus *Hoplolaimus* was first described by Daday in 1905. Thorne² included it in the subfamily *Hoplolaiminae* under family *Tylenchidae*. But Goodey¹ in the year 1963 made separate family *Hoplolaimidae*, which includes *Hoplolaimus*, *Scutellonema*, *Rotylenchus*, *Helicotylenchus* and allied genera. The well-developed head skeleton, deeply striated cuticle, robust spear and prominent phasmids are some of the salient features of this family. In India *H. indicus* was reported by Sher⁴ on *Musa sapientum*, *Pisum sativum*, *Pisidium guajava* and *Lycopersicon esculentum* from Kerela, Delhi and Karnal.

In the State Farm at Berhampur, paddy crop failed for two successive years in some experimental plots. On examining the soil samples it was discovered that this important plant parasitic nematode was associated with the roots of the affected plants. The affected crop could be characterised by stunted growth of the plant and suppression of earhead formation.

The soil sample collected from the State Sugarcane Research Station, Bethuadahari, Nadia District, revealed the presence of *H. indicus*, but most of them were immature. The symptoms of damage were not very clear although, in the early stages, the symptoms noted were stunting of upper internodes, drooping of the foliar system, curling of new leaves and withered tips in the older leaves. But at the later stage the crop recovered.

Some *Basella* plants were found chlorotic in the garden of the State Agricultural Research Institute, Calcutta, during the year 1965, although no causal organism could be apparently detected. However, closer examination of the soil revealed the presence of plant parasitic nematodes which were identified as *H. indicus*.

At Barsul, Burdwan District, soils were collected from a farmer's plot, grown to brinjal, where the crop failed. Examination of the soil revealed presence of *H. indicus*.

In all the cases mentioned above, an intimate association between the host and the parasite was noticed. The nematodes were more numerous in and around the root zone. Microscopic examination of the roots revealed that the nematodes fed mainly on the roots. They punctured the root tissue with the robust stylet and adhered there, keeping free their rear ends. These nematodes are idle in nature and sluggish in movement. It rarely changes its position or moves when kept in a watch glass. When relaxed by gentle heat it assumes an arcuate position (Fig. 1, a). Body width is almost same throughout its length but tapers slightly at the head end. Cuticle is deeply striated. Head skeleton is markedly offset. The stylet is robust and the basal knobs have anteriorly directed points (Figs. 1, d). Oesophageal gland overlaps the intestine. Vulva is situated near about the mid body length. Ovary is paired. Female tail is blunt with striations round the tip (Fig. 1, b). Gonad is distinct in males and a spermatheca is present. Male tail is somewhat pointed at the tip with a big striated bursa (Fig. 1, c). Paired spicules and gubernaculum are prominent.

The measurements of the nematode are:

Female: length—1.2 mm, a —43.3, b —?,

c —48, V —60%, Spear—34 μ .
Male: Spicule—41 μ .

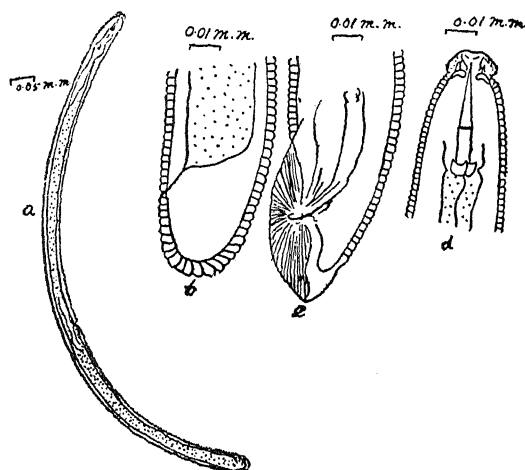


FIG. 1. (a) *Hoploaimus indicus* (Adult female).
(b) Female tail (Magnified).
(c) Male tail
(d) Head end

Authors are thankful to Dr. D. J. Raski and Mr. D. R. Dasgupta (California) for kindly identifying the specimen.

State Agri. Res. Institute,
Entomology Section,
230, Netaji Subhash Road,
Calcutta-40, May 5, 1966.

S. N. BANERJI.
D. K. BANERJI.

1. Goodey, T., *Soil and Freshwater Nematodes*, Re-written by J. B. Goodey, Methuen & Co. Ltd., London, 1963, p. 60.
2. Thorne, G., *Principles of Nematology*, McGraw-Hill Book Co., Inc., New York, 1961, p. 182.
3. Mai, W. F. and Lyon, H. H., *Pictorial Key to the Genera of Plant Parasitic Nematodes*, Department of Plant Pathology, Cornell University, Ithaca, New York, U.S.A., 1962, p. 50.
3. Gopal Swarup and Koshy, P. K., 'A review of work on nematology in India,' *F.A.O. Technical Document No. 47*, F.A.O., Bangkok, Thailand, 1965, p. 18.

STUDIES ON THE EFFECT OF CERTAIN CHEMICALS ON THE HATCHABILITY OF THE EGGS OF *MELOIDOGYNE JAVANICA*

SOME authors have studied the effect of soil fumigants and solubilized chemicals on the hatchability of *Heterodera* cysts.¹⁻³ Jones and Nirula⁴ tested the nematocidal effect of certain compounds *in vitro* by hatching the egg masses of *Meloidogyne* spp. in aqueous solutions of the test chemicals. The fumigatory value of such chemicals in inhibiting the hatch of the egg masses of root-knot nematodes has not so far been assessed. The following experiments were

conducted to examine the effect of D.D., Nemagon, Nematox and Diazinon as contact nematicides as well as fumigants on *M. javanica* (Treub) Chitwood. The egg masses having uniform size, colour and firmness were used in this experiment. All of them were obtained from a single egg mass isolate of *M. javanica* from ash gourd. From each of the test chemicals four different concentrations, viz., 10, 25, 50 and 100 ppm of active ingredients were prepared by diluting with distilled water. The solution under each concentration was pipetted out into four 5 cm. watch glasses and a single egg mass added to each watch glass, which was covered with another watch glass and kept for hatching. The larval hatch was counted every 24 hr. under the stereoscope. The emerging larvæ were removed by means of a hypodermic syringe. Once in two days fresh solutions were added at the rate of 2 ml. per watch glass and the counting continued for a week. The results are presented in Table I.

TABLE I

A comparison of the effect of four chemicals on the hatchability of the eggs of *M. javanica* when tested as contact nematicides

(chemical)	Average number* of larvæ hatched out at different concentrations (ppm)			
	10	25	50	100
D.D. ..	235	210	172	239
Diazinon ..	221	172	40	55
Nemagon ..	242	169	179	174
Nematox ..	185	262	86	101
Control ..	267	267	267	267

* Final counts taken 7 days after treatment.

Statistical analysis of the data indicated that there was no significant inhibition of hatchability of eggs due to D.D. and Nemagon at any of the concentrations tested, whereas Diazinon and Nematox had significant inhibitory effects at all the concentrations.

For fumigating the eggs, the method of Fenwick³ was modified as follows: 20 ml. of distilled water was added to 10 cm. Petri dish and an embryonic cup wrapped with blotting-paper was placed over it. When the paper was moistened thoroughly, 16 egg masses were placed over the stage. Four such Petri dishes were prepared for fumigating with the four test chemicals. Into each Petri dish 0.5 ml. or 0.5 g. of the active ingredient or the chemical, contained in a watch glass, was introduced. At intervals of 15, 30, 60 and 120 minutes, four egg masses from each Petri dish were taken out, placed in four 5 cm. watch glasses containing distilled

water and incubated for hatching. The larval counts were taken at 24 hr. intervals for one week. After each counting the egg mass was transferred to a fresh watch glass containing 2 ml. of distilled water. The data are given in Table II.

TABLE II

A comparison of the effect of four chemicals on the hatchability of *M. javanica* when tested as fumigants

Chemical	Average number* of larvæ hatched out after fumigations for different lengths of time (minutes)			
	15	30	60	120
D.D. ..	28	11	0	0
Diazinon ..	814	838	831	845
Nemagon ..	860	630	540	190
Nematox ..	657	409	5	0
Control ..	843	843	843	843

* Final counts taken 7 days after treatment.

Diazinon was ineffective in inhibiting the larval hatch even after longer duration of fumigation. D.D. and Nemagon, which did not show any significant inhibitory effect as contact nematicides, caused significant inhibition when used as fumigants. The effect of all the chemicals except Diazinon was found to increase with the duration of fumigation. Complete inhibition of hatchability was caused by D.D. at 60 and 120 minutes duration of fumigation and by Nematox at 120 minutes duration of fumigation. Nemagon could not suppress completely the hatch even with the longest duration of fumigation.

Of the four chemicals tested for inhibition of hatchability of *M. javanica* eggs, Diazinon, the soil insecticide, was more effective than the other nematicides when used as a contact chemical. On the other hand, the same chemical was completely ineffective when used as a fumigant. Tarjan² also found that 3-*p*-chlorophenyl-5-methyl rhodamine, which was very effective as a contact ovicide against the egg masses of *M. incognita*, was totally ineffective when applied as a dry powder, even at higher concentrations. In the present studies Nematox was found less effective as a contact nematicide than as a fumigant. Nemagon and D.D. were totally ineffective as contact nematicides. This may be due to their high volatile property.

Microbiology Laboratory, M. THIRUGNANAM.
Annamalai University, *G. RANGASWAMI.
Annamalainagar,
Madras State, May 30, 1966.

* Present address: Dean, University of Agricultural Sciences, Bangalore 24.

1. Peters, B. G., *J. Helminth.*, 1955, 29, 81.
2. Stones, L. E. W., *Ann. Appl. Biol.*, 1956, 44, 292.
3. Fenwick, D. W., *Nematologia*, 1957, 2, 242.
4. Jones, F. G. W. and Nirula, K. K., *Plant Pathology*, 1963, 12, 148.
5. Tarjan, A. C., *Phytopathology*, 1954, 44, 431

ALKALOIDAL CONTENT OF *SOLANUM KHASIANUM* CLARKE

CONFLICTING reports have appeared on the steroidal contents of the fruits of *Solanum khasianum* Clarke. Maiti *et al.*¹ reported yield of solasodine as 5.4% on dry weight basis from the fruits of *Solanum khasianum* Clarke var. *chatterjeanum* Sengupta. Other workers,¹⁻³ however, could not confirm the above-published results and obtained far too low values of solasodine, about 0.5% or less.

Immediately after the report of high solasodine yield by Maiti *et al.*,¹ a systematic work on the cultivation of this species was taken up by the author and his colleagues at the Indian Botanic Garden, Calcutta. Since the results indicate the usefulness of the material for commercial exploitation, it is necessary to clarify some of the procedural details in regard to the proper stage of fruit collection and drying which may be responsible for obtaining poor yields. A brief account of some of these results has already been published.⁵

Fruits of the same physiological age were analysed at about weekly intervals right from this early stage of development. It was found that a progressive accumulation of glyco-alkaloid takes place and that the concentration of glyco-alkaloid is at its maximum (7.4%) when the fruits are about 55-60 days old. This stage of development appears to coincide when the fruit colour just changes from green to yellow (cf. Table I, Saini *et al.*⁵).

The water content of a fruit is roughly about 80% at this stage of growth and besides glyco-alkaloid, it contains a large quantity of carbohydrates. The outer covering of the fruit is sufficiently cutinized to prohibit any loss of moisture under ordinary condition. Drying a whole fruit in the sun, therefore, keeps going almost all the process of destruction of the glyco-alkaloid as if the fruit is still attached to a plant. A prolonged drying period in the open soon brings about fungus attack.

To overcome the problem of drying, it becomes necessary to find out the exact place of maximum concentration of this alkaloid inside a fruit. Analysis of the various parts of a fruit

indicates that the fleshy cover and washed seeds do not contain any alkaloid and that it is concentrated in a mucilage layer all around the seeds. It is, therefore, clear that the process of drying the fruits is responsible for poor yields reported by other workers. After drying, the mucilage layer in a fruit shrinks and forms a white amorphous mass sticking at various points over the surface of the seeds. On further handling of the dry material, much of this white product is easily lost.

Since the alkaloid is concentrated as a particular layer which can easily be exposed to the action of a solvent, it is not necessary to dry and powder the material. The fresh fruits after opening under hand pressure are directly extracted two or three times with hot 3% acetic acid in which the glyco-alkaloid is soluble. It is filtered through muslin cloth and crude glyco-alkaloid is precipitated with dilute ammonia. Further purification of this precipitate is made by the usual method.

Direct extraction with dilute acetic acid eliminates all the bulky material if fresh fruits in the first step and a very large quantity of the material can thus be collected right at the site of fruit collection.

A large number of estimation have been carried out from the fruits collected from different experimental trials and it is found that the glyco-alkaloid yield of this material is about 6% and that of solasodine a little over 2%.

Central Botanical Laboratory, A. D. SAINI.
Botanical Survey of India,
Indian Botanic Garden,
Howrah, May 12, 1966.

1. Chaudhury, S. B. and Rao, P. R., *Ind. Jour. Chem.*, 1964, 33, 424.
2. — and Hazarika, J. N., *Curr. Sci.*, 1966, 35, 187.
3. Hamied, Y. K., *Indian Drugs*, 1955, 2, 37.
4. Maiti, P. C., Mookerjee, S., Mathew, R. and Henry, A. N., *Curr. Sci.*, 1964, 33, 730.
5. Sami, A. D., Mukherjee, M. and Biswas, R. C., *Indian J. Plant Physiol.*, 1965, 8.

RECORD OF *BOTRYDIOPSIS ARRHIZA* BORZI FROM GUJARAT

Six genera including *Botrydiopsis* Borzi of the class Xanthophyceae have been reported from India.¹⁻³ The only record of *Botrydiopsis arrhiza* Borzi from India is from Lucknow.³ In the present communication this species collected from Ahmedabad is described.

Botrydiopsis arrhiza Borzi was found growing amongst *Oscillatoria irrigua* (Kütz.) Gomont., *Lyngbya gracilis* (Menegh.) Rabenh. and *Tolypothrix bouteillei* (Breb. et Desm.) Forti

on an old wall at Krishna Society, Ahmedabad, during the month of August, 1965.

The cells are solitary as well as in clusters but without gelatinous investment. They are usually globose but sometimes spheroidal or slightly pressed. The size of the cells varies from 7 to 10 μ but smaller cells 3 to 4 μ in diameters have also been found. The cell wall is usually thick. Each cell contains two to three parietal chromatophores and a single nucleus. Reproductive cells are not observed.



10 μ

FIGS. 1-3. *Botrydiopsis arrhiza* Borzi. Fig. 1. A solitary vegetative cell. Fig. 2. A cluster of normal cells. Fig. 3. A cluster of small cells.

This species is more often found on moist soil than in strictly aquatic habitats.⁴ At Lucknow, it has been found growing as a planktonic form as well.³ Here it inhabits on a moist wall. The mode of reproduction, viz., the formation of aplanospores shows the adaptability of this species to a terrestrial environment. The morphological differences between the specimen of Ahmedabad and that of Lucknow may, therefore, be of ecotypic nature.

Botany Department,
University School of Sciences,
Gujarat University,
Ahmedabad-9, May 3, 1966.

B. S. VADYA.

1. Biswas, K., *Rec. Bot. Surv. India*, 1949, 15, 1.
2. Prasad, B. N. and Srivastava, P. N., *Curr. Sci.*, 1963, 32 (6), 272.
3. — and —, *Ibid.*, 1964, 33 (19), 596.
4. Prescott, G. W., *Algae of the Western Grate Lakes Area*, Michigan, 1951.

COMPARATIVE EFFECTS OF INDOLE-3-ACETIC ACID, KINETIN AND GIBBERELIC ACID ON THE GROWTH OF ISOLATED CUCURBITA PEPO COTYLEDONS

AMONGST the epigeal seedlings cucurbits are remarkable in that in light, their cotyledons undergo marked expansion and greening, taking up leafy form and function. The factors governing this expansion are as yet obscure. Many studies have shown expansion of leaf discs by kinetin,² gibberellins^{3,4} and also by cobalt.^{5,6} None, however, throw adequate light on the nature of action of these, in controlling

the ultimate leaf form. Since pumpkin cotyledons expand in light in water and this expansion is enhanced by kinetin even on isolation,¹ it was of interest to compare the growth effects of kinetin with that of the other two growth substances, viz., indole-3-acetic acid and gibberellic acid.

Although kinetin and gibberellic acid both caused enlargement of the cotyledons, it was observed that the nature of growth and the ultimate form they produced were different. Table I gives their areas. The cotyledons were isolated from dark grown *Cucurbita pepo* var. King of Mammoths seedlings with about 5 mm. of hypocotyl. They were floated on water, kinetin, gibberellic acid and indole-3-acetic acid solutions for 72 hours under 500 lux light from fluorescent tubes at $28 \pm 2^\circ \text{C}$.

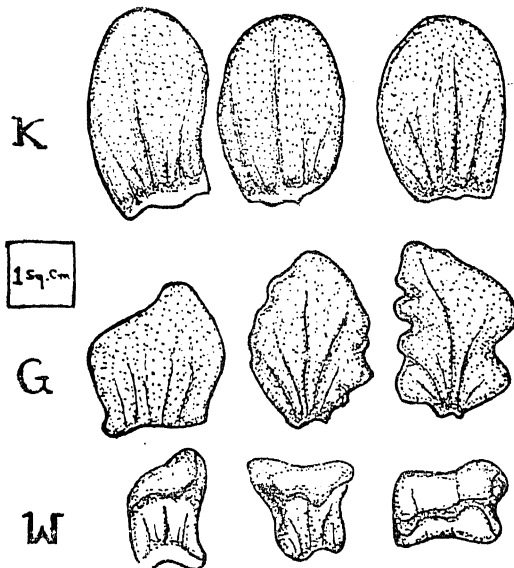


FIG. 1. Showing the different growth patterns in gibberellic acid and kinetin induced expansion of isolated pumpkin cotyledons in light. K=Kinetin 10 ppm. G=Gibberellic acid 100 ppm, W=Water.

While kinetin and gibberellic acid cause marked expansion, indole-3-acetic acid is without any effect. Difference in the kinetin-induced and gibberellic acid-induced growth are evident within the first 24 hours of incubation. In kinetin the cotyledons become boat-shaped while in gibberellic acid they curl downwards along the longitudinal axis. At 72 hours the former are flat, ovate with smooth margin while the latter oblong, pale green and with curly margin.

It is apparent that kinetin causes lateral expansion of the cotyledons stimulating first the growth of the dorsal side and subsequently

of the palisade side. Microscopic examination of the transverse section of the cotyledons and of the epidermal peels showed no marked effect on the cell size suggesting occurrence of cell division.

TABLE I

Showing the expansion of isolated Cucurbita pepo cotyledons in different concentrations of kinetin, gibberellic acid and indole-3-acetic acid in light (Area of cotyledons in sq. cm. \pm S.D.)

		Concentration in ppm.				
		0	1	10	20	100
Kinetin	..	4.0 ± 0.6	4.8 ± 0.6	5.8 ± 0.7	6.7 ± 1.1	..
Gibberellic acid	..	4.7 ± 0.7	5.1 ± 0.4	5.7 ± 0.6	..	6.2 ± 0.8
Indole-3-acetic acid	..	4.0 ± 0.6	..	..	..	4.1 ± 0.7
Initial area	..	1.63 ± 0.3				

Gibberellic acid, it appears, induces first stimulation of the palisade side especially along the veins. Since, laminar tissue is not stimulated to grow to the same extent, the margins get curly. This comparative study manifests interesting involvements of the two groups of growth substances in the overall control of cotyledon growth in intact seedlings and of leaf growth in intact plants, since, both types of compounds are believed to be present in plant tissues.

Botany Department, D. BANERJI.
The University, M. M. LALORAYA.
Allahabad (India), April 26, 1966.

1. Banerji, D. and Laloraya, M.M., *Naturwissenschaften*, 1965, 52, 349.
2. Miller, C. O., *Ann. Rev. Plant Physiol.*, 1961, 12, 395.
3. Hayashi, T. and Murakami, Y., *J. Agric. Chem. Soc., Japan*, 1961, 28, 548.
4. Radley, M., *Ann. Bot.*, 1958, 22, 297.
5. Miller, C. O., *Arch. Biochem. Biophys.*, 1951, 32, 216.
6. —, *Plant Physiol.*, 1952, 27, 408.

RECORD OF A BRACONID PARASITE OF LONGIUNGUIS SACCHARI ZHNT. IN INDIA

Longiunguis sacchari Zhnt. first recorded to be a vector of the virus causing grassy shoot disease of sugarcane in Maharashtra (Chona et al., 1960) has recently been found to be an efficient vector of this virus in North India as well (Singh and Shukla, 1965). While studying the population of this vector on sugarcane leaves in a field in November 1965, a large number of dead aphids were observed in each

colony. The dead aphids were bloated and had turned greyish-white in colour. On further investigation, they were found to be parasitised by a tiny wasp, identified as *Lysiphlebus* sp. (family: Braconidae). This appears to be the first record of *Lysiphlebus* sp. parasitising *Longiunguis sacchari* in India. Box (1953) has reported *Lysiphlebus testaceipes* Cress. parasitising *L. sacchari* in Natal and Hawaii.

Preliminary data collected on this parasite at the Indian Institute of Sugarcane Research, Lucknow, are presented here. *Lysiphlebus* sp. parasitised nymphs as well as adult aphids. The extent of their parasitisation in nature, as recorded from November 1965 to January 1966, is given in Table I.

TABLE I

Incidence of parasitisation of *L. sacchari* by
Lysiphlebus sp. in nature

Months		Per cent parasitisation (Total no. of aphids examined is given in parenthesis)	
		Nymphs	Adults
November 1965	..	16 (176)	28 (118)
December 1965	..	11 (220)	43 (137)
January 1966	..	7 (167)	32 (97)

The parasitised aphids were collected from the fields and kept under observation in the laboratory. It was observed that the adult wasp, *Lysiphlebus* sp., emerged through a circular aperture, apparently cut by it. The parasite failed to emerge from some of the parasitised aphids.

The parasite was also reared in the laboratory on the aphid cultures. It was observed that nymphs and adults which are parasitised become sluggish and do not move much even when disturbed. They swell dorsally but remain flat on the ventral side. Four to six days after parasitisation the swelling becomes more pronounced and the aphids die. The dark brown colour of parasitised aphids is gradually lost and finally the cuticle becomes greyish-white. It would appear that all the body contents of the host are consumed and on the emergence of the adult parasite only an empty carcass is left behind. The carcass remains firmly stuck to the leaves with its legs outstretched.

In the laboratory, at 20° to 26° C., one life-cycle of the parasite was completed in 11 to 20 days. The female wasp inserts its ovipositor (presumably after copulation which has not been observed so far) into the postero-dorsal side of the aphid and takes about 40 to 60 seconds to complete one oviposition. All the

developmental stages of the parasite are completed within the host body and finally the adult emerges through a hole, generally on the postero-dorsal side of the host.

Ambient temperatures appears to affect the duration of the life-cycle of the parasite. It was observed that under laboratory conditions the life-cycle was completed in 17 to 20 days at 20° C.; 13 to 17 days at 24° C.; and 11 to 14 days at 26° C. The ratio of males to females in the laboratory cultures was 43:57 and that from parasitised aphids collected from fields was 58:42.

Detailed studies on the morphology of this parasite (which appears to be a new species), and its relationship with its host are on hand.

The authors are grateful to the Director, Commonwealth Institute of Entomology, London, for kindly identifying the parasite and to Mr. A. N. Kalra, Entomologist, for critically going through the manuscript.

Indian Inst. of Sugarcane Res., KISHAN SINGH.
Lucknow-2, May 6, 1966. U. S. SHUKLA.

1. Box, H. E., *List of Sugarcane Insects*, Commonwealth Institute of Entomology, London, 1953, 70.
2. Chona, B. L., Capoor, S. P., Varma, P. M. and Seth, M. L., "'Grassy Shoot' Disease of Sugarcane," *Ind. Phytopath.*, 1960, 13, 37.
3. Singh, Kishan and Shukla, U. S., "Insect transmission of the grassy shoot disease," *Ann. Rep. Ind. Inst. Sugarcane Res.*, 1954-65, p. 138.

SEXUALITY IN *USTILAGO SCITAMINEA* SYD.

FOLLOWING the demonstration of heterothallism in *Ustilago violacea*¹ it has been shown that sexuality in the smuts may be bipolar or multipolar.¹ Dikaryotization is usually needed for pathogenicity.⁵ Sexual compatibility groupings and their relationship to pathogenicity were studied in *U. scitaminea* Syd., the sugarcane smut organism.

Teliospores of sugarcane smut from different South Indian localities and different varieties were stored over CaCl₂ to preserve their viability indefinitely. Thereby collections made over a 3½-year period were studied. Teliospores were germinated in films of sterilized 1% sucrose solution. Each of the four sporidia produced by the promycelium was collected separately using a Leitz micromanipulator. Sporidia from 72 teliospores were grown on yeast extract-malt extract agar.¹ Monosporidial cultures were buff-coloured, mucoid colonies consisting of budded off secondary sporidia. Colonies had mostly a finely crenulated or occasionally deeply lacera-

ted margin. Colony type was not related to sex group.

When pairs of compatible haplont cultures were mixed on a drop of 1% sucrose solution in van Tieghem cell cultures a short fusion tube appeared within an hour from near one end of the sporidium and fused with a similar tube from a neighbour. Fusion tubes appeared only in the presence of the compatible opposite sex. Following fusion sporidial budding ceased and a hypha grew out to develop a branched mycelium. With incompatible cultures fusion did not occur and sporidia continued to bud off more secondary sporidia without hyphal formation. Compatibility was confirmed by a 'Bauch Test'² on yeast extract-malt extract agar plates. A cottony white mycelium developed from mixtures of compatible pairs but cultures of incompatible pairs remained as mucoid colonies.

Each promycelium gave rise to 2 sporidia of the plus and 2 of the minus sex. Study of all possible combinations among sporidia from 20 promycelia indicated the presence of only two sex types. Among 288 sporidia from 72 promycelia, four cases of haplolethal deficiency³ were encountered all of which were determined, by elimination to belong to the minus sex.

Surface-sterilized buds of single-eye setts from healthy plants of sugarcane varieties Co. 213 and C.P. 33-409 were inoculated by placing a drop of sporidial suspension on them, incubated for 12 hours in a humidity tent and planted in soil. Three 'plus' and three 'minus' haplonts were used singly and in all possible combination pairs. Dual controls consisted of 'no inoculation' and inoculation with teliospore suspension. Twenty-five buds were inoculated in each case. Uninoculated controls and buds inoculated with incompatible pairs of haploid lines or with unpaired cultures gave rise to uninfected plants. Buds inoculated with pairs of compatible lines gave rise to varying numbers of infected plants which developed smut whips in 8 to 10 weeks (Table I). With teliospore

TABLE I
No. of plants infected following inoculation
with pairs of compatible sporidial lines
(Co. 213: C.P. 33-409)

Haploid lines				
Plus	Minus	VIII A	XI B	XIV D
XII B		14; 3	17; 4	2; 12
XVII C		7; 4	18; 5	5; 16
XVIII A		2; 1	14; 19	15; 3

inoculation 17 plants of Co. 213 and 15 of C.P. 33-409 produced smut whips.

There was an indication that not only did the degree of virulence vary with the combination of haplonts but there also appeared to be differences in susceptibility of the two varieties to different combinations of haplonts.

Sugarcane Breeding Inst., K. C. ALEXANDER.
Coimbatore-7. K. V. SRINIVASAN.
May 31, 1966.

1. Bauch, R., *Zeitschr. f. Bot.*, 1923, 15, 241.
2. —, *Biol. Centralbl.*, 1927, 47, 370.
3. Fischer, G. W., *Mycologia*, 1940, 32, 275.
4. Kniep, H., *Zeitschr. f. Bot.*, 1919, 11, 275.
5. Stakman, E. C. and Christensen, J. J., *Phytopathology*, 1927, 17, 827.

ELSHOLTZIA INCISA BENTH.: A NEW SOURCE OF THYMOL IN NORTH-WEST HIMALAYAS

DURING the course of an investigation on the aromatic plant resources of North-West Himalayan region, the leaves and the flowering tops of *Elsholtzia incisa* Benth. (Labiatae) were found to emit a strong smell identical with that of thymol. The herb was collected from Reasi Forest Division in Jammu and Kashmir State during the month of October 1964. The dried leaves and flowering tops on hydro-distillation yielded 0.88% (v/w) of a pale yellow oil with a strong smell of thymol. The oil was found to possess the following properties:

Specific gravity at 25° C.	..	0.9397
Refractive index at 25° C.	..	0.5050
Percentage phenols calculated as thymol	..	53.8

The oil on chilling deposited large crystals, the identity of which was confirmed by TLC comparison with an authentic specimen of thymol using two different solvent systems on silica gel layers (solvent systems: benzene R_f 0.40; benzene chloroform 1 : 1, R_f 0.43). The oil was also subjected to gas liquid chromatography where the major band accounting for about 60% of the oil had retention time identical with that of thymol. This appears to be the first report of the occurrence of thymol in substantial quantities in the genus *Elsholtzia*.

The plant is a pubescent slender herb (plate) about one metre high. Leaves are ovate, 5 to 8 cm. long, coarsely toothed with the base tapering along the length of the petiole. Spike, slender, 6 to 10 cm. in length with small white

flowers in interrupted whorls. It flowers during the months of July and August and frequently grows in open moist edges of temperate or sub-temperate forests between 1900 and 2200 m. The plant material is commonly available from various localities throughout North-West Himalayas extending from Jammu and Kashmir to Kumaon and parts of Western Nepal under similar habitat conditions. A detailed technoeconomic survey of the raw material has since been taken up.

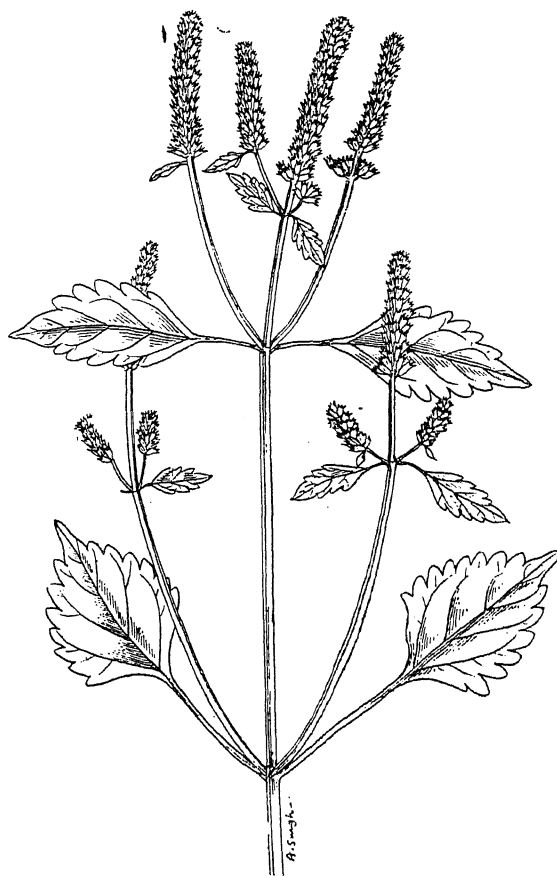


FIG. 1. *Elsholtzia incisa* Benth.; aerial portions.

The authors are grateful to Dr. K. Ganpathi, Director, for his great interest in this work. Thanks are also due to Dr. C. K. Atal for useful suggestions, and to Shri Ajendra Singh for the preparation of the illustration.

Regional Research Y. K. SARIN.
Laboratory, V. S. PRABHAKAR.
Jammu (Tawi), June 23, 1966.

REVIEWS AND NOTICES OF BOOKS

Ultraviolet Spectra of Elastomers and Rubber Chemicals. By V. S. Fikhtengol'ts, R. V. Zolotareva and Yu. A. L'vov. (Plenum Publishing Corporation, 227 West 17th Street, New York, U.S.A.), 1966. Pp. 170. Price \$9.00.

Ultraviolet spectroscopy finds application in the analysis of a great variety of substances used in the manufacture of synthetic rubber. Determination of impurities in monomers and intermediate products, composition of polymers, control of copolymerisation, estimation of various ingredients in rubber, are some examples in this regard. The present publication is an atlas of charts giving absorption spectra in the near ultraviolet (200–400 m μ) for 141 different substances met in synthetic rubber manufacture. These include monomers, polymers, organosilicon compounds, antioxidants, and other auxiliary materials as emulsifiers, initiators, regulators, etc.

The spectra are represented in the form of graphs relating the specific extinction coefficient (α) with the wavelength (λ) in millimicrons. This English translation of the original Russian text will be found useful by practical spectroscopists engaged, not only in rubber industry but also in many other allied industries. A. S. G.

Modern Developments in Powder Metallurgy (Vols. I, II and III). Editor: Henry H. Hausner. (Plenum Publishing Corporation, 227 West 17th Street, New York), 1966. Pp. 398 + 350 + 275. Price \$80 per set.

During the past decade metal powder producing and consuming industries have been rapidly expanding. New methods have been developed for the production of metal powders and for the consolidation of powders. Experiments which were confined to laboratories a few years ago have been successfully developed into production methods and are increasingly being used internationally in all industrial centres. In fact, powder metallurgy has become one of the international sciences with a justifiable claim for the holding of International Conferences for discussions of results and developments in techniques of production and applications.

The First International Conference on Powder Metallurgy was held in 1960. Since then many new applications of powder metallurgy-prepared materials have been developed. The technique provides an important method for the

fabrication of fuel elements for nuclear reactors. Its importance in space technology is also becoming apparent. In this context the holding of the Second International Conference in Powder Metallurgy in June 14–17, 1965 in New York has been timely. Sixty-three papers dealing with fundamentals and practice of powder metallurgy were presented by authors from sixteen countries.

The proceedings of this Conference—the papers as well as some of the discussions—have been brought out in the three substantial and well got-up volumes under review. The first volume on Fundamentals and Methods contains 22 papers on the more theoretical aspects of powder production, testing, mining, consolidation and sintering; the influence of production techniques on the physical properties of powders and their measurements; pressing of powders involving isostatic techniques, rolling, hot extrusion, slip casting, etc. The papers on Applications in Volume 2 are arranged under the heads: Ferrous Powder Metallurgy, Dispersion Strengthening, and High Temperature Materials. Volume 3 deals with Development and Future Prospects under the headings: Nuclear Applications; Cemented Carbide, Friction, Thermoelectric, Porous and Heavy Metal Materials; Research, Trends, and Future. A. S. G.

Clinical Dietetics and Nutrition. By F. P. Antia. (Oxford University Press, Madras-2), 1966. PP. 563. Price Rs. 35.

The importance that diet plays in the prevention and treatment of diseases cannot be overemphasised. There are many books on the subject but the one under review has been specially written to be of use to students of physiology as well as to general medical practitioners. The author is a physician of vast experience in clinical medicine, particularly, gastroenterology.

The book is in four parts. The first part contains chapters on calories, proteins, fats, carbohydrates, vitamins and minerals. The second part on Foods describes the common foodstuffs wheat, pulses, rice, egg, meat, fish, vegetables and fruits, beverages, etc., their nutritional contents and clinical uses. Part III on Clinical Dietetics discusses the diets recommended for particular diseases. The last part

gives Tables of Food Values, and many other useful tables.

Although the book has been written with special reference to India, it will be of value to many other countries where intestinal disorders are common and nutritional problems have to be tackled. It will be a useful addition to any household bookshelf as a ready reference book on a subject which affects every individual.

A. S. G.

Essentials of Palynology. By P. K. K. Nair. (Asia Publishing House, Bombay-1), 1966. Pp. 96. Price Rs. 9.

Palynology, the science concerning the study of pollen and spores, notwithstanding much recent work on the subject, has not yet become a detailed topic included in botany teaching in colleges at under-graduate levels. The present publication will form a useful introductory text-book for the purpose. The introductory chapter on Aspects and Prospects gives a general background. This is followed by the chapter on Pollen and Spore Morphology. The study of pollen grains and spores in air is covered by the chapter on Aeropalynology. Melittopalynology deals with pollen and honey-bees. The last chapter is on Fossil Palynology.

A. S. G.

Human Ecology—Collected Readings. By Jack B. Bresler. (Addison Wesley Publishing Co., Inc., 10-15, Chitty Street, London W. 1), 1966. Pp. 472. Price \$9.75.

This publication contains a collection of 30 articles published in well-known science journals, mostly American, like *Science*, *Evolution*, *American Scientist*, *American Anthropologist*. The collection has been designed by the author for a course in Human Ecology given at Boston University. It gives an historical approach to environmental factors that have affected man, and takes a deterministic view that man must either adapt to his environment or die. Articles of a controversial nature have also been included, but they all add to the general appreciation of the subject as a whole.

The following are subjects and titles of some of the articles selected at random: Climates of the Earth; Temperature and the Evolution of Man; The Land and Disease Patterns; An Epidemiological Study of Congenital Malformation in New York State; Variation in Neonatal Death Rate and Birth Weight in the United States and Possible Relations to Environmental Radiation, Geology and Altitude; Influence of the Environment on the Unborn; World

Population Growth—An International Dilemma; Air Conservation; Effect of Smog; Some Environmental and Cultural Factors Influencing the Structure of Australian Aboriginal Population; Environment and Man in Arid America; Polonium-210 in Cigarette Smoke.

The tale of "The Hare and the Haruspex" concerning the quaternial migration of the Scandinavian lemmings has been delightfully told. The last two articles relate to Man in Space. One is American astronaut Glenn's observations during the First US manned orbital space flight, and O'Keefe's comments on them. The other is on Martian biology.

The collection provides interesting reading to a thinking mind keenly aware of the fact that we are in a period when the biology of the human race is undergoing continuous change measured in terms of health, fitness, and genetic constitution.

A. S. G.

Books on Indian Flora

The Flora of Delhi. By J. K. Maheshwari. (Council of Scientific and Industrial Research, New Delhi), 1963.

Illustrations to the Flora of Delhi. By J. K. Maheshwari. (Council of Scientific and Industrial Research, New Delhi), 1966. Pp. 282. Rs. 28.00; 56 sh.; \$8.00.

The two volumes are important additions to botanical literature with special reference to Indian Flora. In the *Flora of Delhi* the author has described 531 indigenous or naturalized species, and 411 cultivated species of angiosperms. The data under each item include key to family, genera and species, short description of the species, references to literature, local names and uses, and times of flowering and fruiting. The second book, which is a supplement to the above, contains 278 full-page illustrations of the plants belonging to 206 genera and 66 families described in the *Flora of Delhi*. Each illustration carries an appropriate scale, and the legend includes notes on the colour of flowers, fruits and seeds.

The Orchids of Bombay. By H. Santapau and Z. Kapadia. (Published by the Manager of Publications, Civil Lines, Delhi), 1966. Pp. 239. Price Rs. 15.50; 36 sh.; \$5.58.

The book is a reprint of a series of articles published in the *Journal of Bombay Natural History Society* in 1959-63 under the title "Critical Notes on the Orchidaceae of Bombay State". It is a revision of the family Orchidaceae intended to bring up-to-date the treatment of the

family by Th. Cooke in his *Flora of the Presidency of Bombay* and by E. Blatter and C. McCann in *Revision of the Flora of Bombay Presidency* published in 1931-32 in the *J. Bomb. Nat. Hist. Soc.* The revision was undertaken by the junior author under the guidance of the senior author for the Ph.D. of the University.

The Flora of Pavagadh (Gujarat). By A. R. Chavan and G. M. Oza. (M.S. University of Baroda, University Publications Sales Unit, Near Palace Gate, Baroda-1), Pp. 296. Price Rs. 12-00.

This is the Ph.D. thesis of one of the authors that has been published in book form by the University. It consists of an annotated list of all the phanerogamic species collected on Pavagadh Hill. The description of plants includes correct name and references, synonyms, ecological habits, local name and uses, flowering and fruiting times. No illustrations.

Excursion Flora of Simhachalam Hill. By D. C. S. Raju. (Author's Copyright, Published by D. V. L. N. Raju), Trustee, Devasthanam, Penumantra.

This cheaply produced little pamphlet of 28 pages is an annotated list of vascular plants of the small hill station Simhachalam near Waltair, Andhra Pradesh. It will be a useful guide-book to student collectors and excursion botanists of this area.

Fluidization and Related Processes: A Symposium. (Council of Scientific and Industrial Research, New Delhi), 1966. Pp. 272. Price Rs. 24-00; 48 sh.; \$ 8.00.

Fluidization is the technique of fluid-solid contacting which found commercial application first in Germany after the First World War, and later in U.S.A. during the Second World War. For the past two decades chemical engineers have been taking an active interest in this field of interaction of fluid-solid systems and its application to industry. Individual laboratories in India have also been actively engaged during the past decade in researches on fluidization and related processes, and considerable work has been done. A symposium was held on the subject at the Indian Institute of Technology, Kharagpur, in January 1964, for exchange of ideas and co-ordination of further research in this field.

The publication under review contains 27 papers presented at the symposium. They have been grouped under the following heads: Fundamental Measurements; (2) Physical Interpretation and Momentum Transfer (9); Mass Transfer (3); Heat Transfer (5); Chemical Reactions (8). The collation is bound to be useful to research workers in laboratories and in industry.
A. S. G.

Botanical Monograph No. 4—Indian Fossil Pteridophytes. By K. R. Surange. (Council of Scientific and Industrial Research, New Delhi), 1966. Pp. 209. Price Rs. 23-00; 46 sh.; \$ 8.00.

The rich literature, extending over nearly a century, on Indian fossil plants is all scattered in research journals and departmental reports and publications. These are not easily available to students of palaeobotany. Hence the undertaking by the CSIR to bring out a series of monographs on fossil floras of India, as in other fields of research, is a welcome one. The present monograph is the first in this series, and the compilation on the known species of Indian pteridophytes includes Psilophyta, Lycopodophyta, Arthrophyta and Pterophyta. The chapter on 'General Considerations' gives a valuable comparative account of the fossil pterophytes of the Southern Hemisphere.

The author is the Director of the Birbal Sahni Institute of Palaeobotany which is actively engaged in these investigations thus adding new information on the subject. The monograph is authoritative, well illustrated and excellently produced.
A. S. G.

Books Received

Continuum Mechanics I. The Mechanical Foundations of Elasticity and Fluid Dynamics. By C. Truesdel. (Gordon and Breach Science Publishing, New York), 1966. Pp. xvi + 218. Price \$ 7.50.

Recent Developments in Particle Symmetries. Edited by A. Zichichi. (Academic Press, Inc., New York), 1966. Pp. xii + 460. Price \$ 12.00.

Fundamentals of Radiobiology (Revised 2nd Edition). By Z. M. Bacq and P. Alexander. (Pergamon Press, Headington Hill Hall, Oxford), 1966. Pp. xii + 562. Price not given.

Semiconductor Circuits—Theory, Design and Experiment. By J. R. Abrahams, G. J. Pridham. (Pergamon Press, Headington Hill, Hall, Oxford), 1966. Pp. viii + 310. Price 30 sh.

RADIOTONE PRODUCTS

RADIOTONE products cover a wide range of articles in Electrical and Electronic Industry.

- ✱ Selenium metal rectifiers.
- ✱ Rotary switch up to 11 pole 11 way.
- ✱ Potentiometers, adjustable resistances for different ratings.
- ✱ Spectral chokes/ballasts for SV, MV, Wotan, Fluorescent lamps, etc., etc.

These as well as battery chargers, D.C. Units, and Transformers for various ratings are our special products and in demand with Industry, Trade & Govt. Departments.

Write giving details of your requirements. You will find our quotations for these and transformers, rectifier units, etc., etc., very attractive.

Radio Electric Private Limited

Manufacturers of Radiotone Products
Lamington Chambers, Lamington Road
BOMBAY-4

SP/RE/4

Tempo

N.T.C. RESISTORS (Thermistors)
Beads, Pellets & Glass Probes

CERAMIC MAGNETS
Cylindrical & Bar Types

For further details contact :

ELE Department,
TEMPO INDUSTRIAL CORPORATION
Engg. Divn. of Primco (P.) Ltd.
394, Lamington Rd., Bombay-4, BR.
PHONE : 358033

We have the pleasure to announce that we are appointed by M/s. BOROSIL GLASS WORKS LTD., BOMBAY, as one of their *Authorised Distributors* for their

"BOROSIL" & "CORNING"

Brands
LABORATORY GLASSWARE

N.B.— "CORNING" Brand Glassware are now manufactured by M/s. Borosil Glass Works Ltd., in joint collaboration with CORNING GLASS WORKS, Corning, N.Y., U.S.A., a world leader in this field.

We hold substantial stocks of both BOROSIL and CORNING Glassware which can now be supplied by us at the FACTORY PRICES.

For full details and prices, please contact

UNIQUE TRADING CORPORATION

221, SHERIFF DEVJI STREET

Grams : UNILAB

BOMBAY-3

Phones : 326227,—28.

(Also Stockists of Whatman Filter-Papers, Laboratory Porcelain & Silicaware, Thermometers & Hydrometers & 'QUICO' Scientific Electrical Instruments)

OCURRENCE OF 3, 4, 2', 4', 6'-PENTAHYDROXY CHALKONE IN THE PETALS OF *HELICHRYSUM BRACTEATUM*

V. KRISHNAMOORTHY AND T. R. SESHADRI

Department of Chemistry, University of Delhi, Delhi-7

EARLIER Narasimhachari and Seshadri¹ made a study of the natural occurrence of hydroxy chalcones and flavanones and also the stability of natural and synthetic compounds in the presence of acids and alkali and came to the conclusion that chalcones having 2', 6'-hydroxy substituents are unstable and therefore do not occur free because they are readily converted into the corresponding flavanones. The examples were naringenin, eriodictyol, hesperitin and their glycosides which commonly occur in plant materials; but the corresponding chalcones are not found. In special cases where the glycosides of the chalcones occur free, the sugar groups are found linked to one of the 2' and 6'-hydroxyl groups: e.g., neo-sakuranin² and isosalipurposide.³ Based on these considerations the constitutions of carthamin and xanthohumol⁴ were suggested to be 6'-glucoside and 6'-methyl ether respectively of the corresponding chalcones. Later on from other data these have been proved to be correct.^{5,6}

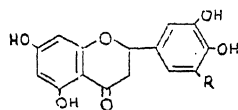
However, Shimokoriyama⁷ recorded that in the case of naturally occurring 7-glycosides of flavanones, the corresponding chalcone glycosides can be made in the laboratory under carefully controlled conditions. The chalcone glycosides can be kept in the cold, particularly in the absence of acids and some of them can be even crystallised. They were unstable in the presence of acids and rapidly underwent change into flavanones.

More recently certain naturally occurring compounds⁸ have been given the unstable dihydroxy-chalcone structure. It seems to us that correct information about these chalcones have not so far been obtained because they are not occurring free so commonly and the conditions of synthesis are too unsuitable for their satisfactory preparation: e.g., Farkas, Nogradi and Major⁹ have recently synthesised 4, 2', 4', 6'-tetrahydroxy chalcone 4'- β -D-glucoside and observed that it is highly unstable to heat. The melting point could not be determined because of the rapid isomerisation and further the sample could not be dried to remove water of crystallisation.

Our recent study of flowers of *Helichrysum bracteatum* seems to indicate that the above type of unstable chalcones are more commonly

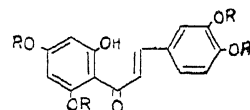
occurring than we originally imagined. A few years back Rimpler, Langhammer and Frenzel¹⁰ studied these flowers and noted that besides other components they contain the flavanones eriodictyol (I) and 5'-hydroxy eriodictyol (II). These were accompanied by the related chalcone glycosides which on hydrolysis with acids gave rise to these flavanones and were therefore reported to be the chalcone 6'-glycosides. We have now examined the ether extract of these flowers which is free from glycosides.

In our present investigation the flowers were collected from the University garden. The air-dried petals were first extracted with light petroleum (60-80°) and then with ether. Ether extract was evaporated and the residue subjected to chromatographic examination when it has been found to contain four compounds two of which having higher R_f values were almost colourless but developed an yellow colouration when exposed to ammonia and were in negligible amounts. Separation on a preparative scale was effected using the descending paper chromatography technique and the bands were cut and eluted with methanol. For the chromatography the upper phase of butanol, acetic acid, water system (4:1:5, v/v) was more convenient in comparison to other solvent systems.



I, R = H

II, R = OH



III, R = H

IV, R = CH₃

The compound with R, 0.65 BAW^b has been studied in greater detail. It has been obtained as an yellow crystalline solid. It gave a greenish-brown colour with alcoholic ferric chloride and an orange red colour with ammonia. Mg/HCl and Zn/HCl reactions were negative. It gave a positive borohydride colour reaction (magenta). The colour reactions and U.V. characteristics showed that it is a chalcone. $\lambda_{\text{max}}^{\text{methanol}}$ 282, 327 (inf.), 376 (the band at 376 m μ being more intense); with AlCl₃, 282, 475-480; with NaOAc, 325, 403; with NaOMe, 325, 430-435 and with boric acid and NaOAc, 280, 320, 410 m μ . The

chalkone did not contain any methoxyl group (micro ziesel). It was found to be identical with the one obtained from eriodictyol (co-chromatography) proving it to be 3, 4, 2', 4', 6'-pentahydroxy chalkone (III).

According to Narasimhachari and Seshadri eriodictyol when treated with 10% aqueous potash and kept at room temperature for $\frac{1}{2}$ hr. and acidified in the cold was recovered unchanged. We have used 20% aqueous alkali and 12 hrs.; on chromatography the product showed one weak yellow spot and another one which developed yellow colour (major portion) on exposure to ammonia. When Shimokoriyama's method,⁷ boiling with aqueous potash (0.5 g. in 1 ml. of water) for 2 mts. is adopted the crude product showed a single yellow spot and a very faint spot due to some eriodictyol. The chalkone had a melting point of 140–42°; usually the melting point of a chalkone is about 10° lower than the corresponding flavanone; eriodictyol melts at about 267°. The lower melting point of the chalkone may be due to rapid isomerisation. It is highly unstable in presence of acids and also to heat and yields eriodictyol when boiled with alcoholic hydrochloric acid.

On methylation with dimethyl sulphate and potassium carbonate in acetone (10 hr.) it gave a tetramethyl ether, m.p. 146–47°, which gave a

positive ferric reaction, and has been found to be identical with synthetic 2'-hydroxy-3, 4, 4', 6'-tetramethoxy chalkone (IV). The identity was proved by T.L.C. and mixed melting point. The n.m.r. spectrum of the methyl ether was taken in CDCl_3 using tetramethyl silane as the internal standard and the signals are given below: -4.45τ (2'-Hydroxy proton); 2.28τ (olefinic protons); 3.2 to 2.7τ (3 aromatic protons of A ring at 2, 5 and 6); 4.03 and 3.87τ (two meta coupled protons at 3' and 5'; $J = 3$ CpS) and 6.17 and 6.09τ (12 protons of the methoxyls at 3, 4, 4', 6').

1. Narasimhachari, N. and Seshadri, T. R., *Proc. Ind. Acad. Sci.*, 1948, **27A**, 223; *Ibid.*, 1949, **30A**, 271.
2. Puri, B. and Seshadri, T. R., *J. Sci. Ind. Res.*, (India), 1954, **13B**, 698.
3. Charaux, C. and Rabate, J., *Bull. Soc. Chim. boil.*, 1931, **13**, 814.
4. Parthasarathy, M. R. and Seshadri, T. R., *Curr. Sci.*, 1961, **30**, 333.
5. Seshadri, T. R. and Thakur, R. S., *Ibid.*, 1960, **29**, 57.
6. Orth, W. A. and Riedl, W., *Ann.*, 1963, **663**, 74.
7. Shimokoriyama, M., *J. Am. Chem. Soc.*, 1957, **79**, 4199.
8. Nilson, M., *Acta Chim. Scand.*, 1961, **15**, 211.
9. Farkas, L., Nogradi, M. and Major, A., *Chem. Ber.*, 1955, **98**, 2926.
10. Rimpler, Von. H., Langhammer, I. and Frenzel, H. J., *Planta Medica*, 1963, **3**, 325.

EFFECT OF CHLORINATION OF WATER ON CONTROL OF BACTERIAL LEAF BLIGHT OF RICE, CAUSED BY *XANTHOMONAS ORYZAE* (UYEDA AND ISHIYAMA) DOWSON

S. Y. PADMANABHAN AND S. S. JAIN

Central Rice Research Institute, Cuttack

RECENTLY, Thompson¹ reported that spread of bacterial stalk rot of corn could be checked by chlorination of water in sprinkler irrigation to give a concentration of 1 ppm residual chlorine. Our attention was drawn to these results by Dr. B. L. Renfro of the Rockefeller Foundation, New Delhi, with the suggestion that this method could be given a trial for the control of bacterial blight of rice. Since infection of *Xanthomonas oryzae* spreads rapidly through irrigation water (Inoue et al.,² Tagami et al.³) it was thought worthwhile to conduct a field trial to study the effect of chlorination of water on control of bacterial blight. The results of the field trial conducted at the Central Rice

Research Institute Farm, Cuttack, during Kharif, 1966 are discussed below:

The chlorine application was tried on large plots of the varieties *Taichung Native-1* and *IR-48* (*Taichung Native-1* \times *Taichung-65*), the high-yielding varieties which are very susceptible to bacterial blight. There were 3 plots of 50 cents of each of the two varieties covering a total area of 3 acres.

The treatments included were: (i) Application of chlorine at 1 ppm in the form of bleaching powder containing 30% chlorine (2 kg./ha.), (ii) Application of 5 sprayings with antibiotic (Streptocycline) + copper oxychloride (3 gm. antibiotic + 113 gm. of copper oxychloride in

25 gallons of water), first at the seedling stage 15 days after germination, and the remaining four at 10-day intervals, beginning from 60 days after germination, (iii) Control (no treatment).

Bleaching powder was thoroughly mixed with powdered dry soil and sprinkled uniformly in small quantities by hand to the standing water which was 5-6 cm. high. This treatment was carried out only once on August 24, 1966 when the crop was 74 days old.

The first spraying with Streptocycline + Cu was carried on June 28 in the seed-bed. This was followed by four subsequent sprayings of the crop on August 12 and 23, September 6 and 16, 1966.

Bacterial blight of rice generally starts in distinct patches covering a few plants and spreads rapidly therefrom. The disease was first noticed on August 30 occurring in a few patches in *Taichung Native-1* and in *IR-48*. The incidence of the disease was estimated twice during the season, on September 9 and 10 and again on September 24 and 25, 1966. The disease was estimated by counting the number of disease pockets in each of the 6 individual plots. The total number of blight-affected plants in each pocket was also found. Finally, the total number of infected plants in each treatment was worked out. The data obtained are set out in Table I.

It might be seen from Table I that the number of foci of infection and the total infected plants were significantly less in the plots treated with chlorine as compared to the control (untreated plots). Besides, the rate of spread of infection was most rapid in the control plots. Spraying with Streptocycline + Cu was found to be almost as effective as chlorination of water in checking the spread of the disease. But chlorination of water is economical since the cost of bleaching powder used was Rs. 1.25 per acre as against Rs. 17.00 involved in case of treatment with antibiotic and copper fungicide.

Further, it was found that *IR-48* was completely free from infection in the observation recorded about 12 days after the appearance of the disease under both the chlorine and antibiotic treatments, and in the second observation 15 days later it was associated with significantly

less infection as compared to *Taichung Native-1*. *IR-48* is slightly less susceptible to bacterial blight. Therefore, the disease could be checked more effectively in this case.

TABLE I
The effect of treatments on the incidence of bacterial blight

Treatments	Variety	Disease incidence			
		Number of Disease pockets		Number of Infected plants	
		Sept. 9-10	Sept. 24-25	Sept. 9-10	Sept. 24-25
1	2	3	4	5	6
Chlorine at 1 ppm	<i>Taichung Native-1</i>	2	9	12	135
do.	<i>IR-48</i>	Nil	4	Nil	35
Spraying with Antibiotic + Copper	<i>Taichung Native-1</i>	3	5	18	159
	<i>IR-48</i>	Nil	1	Nil	13
Control (no treatment)	<i>Taichung Native-1</i>	13	76	157	2845
	<i>IR-48</i>	6	78	71	3319

Based upon these results it is considered that the current recommended plant protection measures for bacterial blight comprising of seed treatment followed by spraying with antibiotic and Cu¹ could be improved upon by including one or two applications of chlorine and cutting down the number of antibiotic sprays to the minimum. This is being worked out.

The help rendered by Shri S. Patnaik, Agricultural Chemist, in determining the chlorine content in bleaching powder and working out its dosage is gratefully acknowledged. Thanks are also due to Shri C. N. Relwani, Farm Superintendent, for the help rendered in raising the crop.

1. Thompson, D. L., *Crop Science*, 1965, 5, 369.
2. Inoue, Y., Goto, K. and Ohata, K., *Bull. Div. Pl. Breed. Tokai-Kinki agric. Exp. Sta.*, 1957, 4, 74.
3. Tagami, Y. S., Kuhara, S., Kurita, T., Fugii, H., Sekiya, N., and Sato, T., *Bull. Kyushu Agric. Exp. Sta.*, 1964, 10, 23.
4. Jain, S. S., Reddy, P. R. and Padmanabhan, S. Y., *Indian Phytopath.*, 1966, 19, 129.

PRESENCE OF AN INHIBITOR IN THE "SEEDCOAT" OF RAGI

K. S. KRISHNA SASTRY AND M. J. DAWSON

Plant Physiology Section, University of Agricultural Sciences, Bangalore-24

THE experiments of Kidd and West¹ showed that germination of barley and other cereals could be hastened by presoaking. Chippindale² had demonstrated this in many other species of Graminae. During the process of seed-hardening in ragi it was observed in this laboratory that seeds treated with 50% moisture followed by drying at room temperature, germinated earlier and also showed initial vigour.³ Several reports show the presence of a germination inhibitor in the seed-coats of different species of plants.⁴⁻⁶ There are instances as in *Euphorbia* sp., and *Dectis papposa* where the seeds contain a water-soluble germination inhibitor, which can be easily leached with water. When the leached seeds were placed in their own leachate, they did not germinate.⁷ The possibility of the existence of such a germination inhibitor in the 'seedcoat' of ragi was examined, as a possible explanation for the earlier germination and vigour in the treated seeds.

Aqueous leachates from seeds of three varieties of ragi H. 22, Aruna and Annapurna were prepared by soaking 100 mg. of seeds in 100 ml. of distilled water for 24 hr. with occasional stirring. At the end of the 24 hr. period the remaining water was filtered and the filtrate used for test as the leachate. In one variety Annapurna, air was bubbled through the seeds, during the period of soaking. This is referred to as the aerated leachate. The pH of these leachates, immediately after filtering, was 6.2, 4.7, 5.1, 7.4 for H. 22, Aruna, Annapurna and Annapurna (aerated) respectively.

Germination tests were conducted in petri dishes with filter-paper soaked with the test leachate. Each petri dish had 4 ml. of the leachate. The effect of the leachate was compared with water in each variety. The number of seeds germinated (emergence of the radicle was taken as the criterion for germination) was counted at the end of 24 hr. and 48 hr. The data on germination are presented in Table I. It can be seen that germination is inhibited in the initial stages; however, at the end of the 48 hr. period the inhibitory effect is overcome in the variety H. 22. In the varieties Aruna and Annapurna even though there was an increase in the percentage of germination with time, the inhibitory effect is still pronounced.

The seeds of Annapurna seem to be more susceptible.

TABLE I

Effect of the aqueous leachates of different varieties of ragi on the percentage germination of the same variety and on that of other varieties. Data represent average of two experiments for 24 hours and 48 hours

	H ₂₂		Aruna		Annapurna	
	24 hrs.	48 hrs.	24 hrs.	48 hrs.	24 hrs.	48 hrs.
Water ..	92	94	78	89	55	81
Leachate of H ₂₂	60	93	30	86	27	46
Leachate of Aruna	52	86	39	67	20	61
Leachate of Annapurna	59	90	37	69	12	57
Leachate of Annapurna (aerated)	82	92	62	78	25	48

Regarding the growth of the coleoptile (including the primary leaf) and the seminal root also the leachates had inhibitory effect, as can be seen from the data in Table II. The inhibitory effect is more pronounced in the variety Annapurna with the leachate from

TABLE II

Effect of the aqueous leachates of different varieties of ragi on the growth of the coleoptile and seminal root of the same variety and on that of other varieties of ragi at the end of 48 hours. Data represent the average of three experiments for coleoptile length and two experiments for root length

	H ₂₂		Aruna		Annapurna	
	Length of coleoptile	Length of root	Length of coleoptile	Length of root	Length of coleoptile	Length of root
	(mm.)					
Water ..	10.3	12.0	6.6	13.0	5.3	15.5
Leachate of H ₂₂	6.6	8.5	4.3	7.5	3.0	6.5
Leachate of Aruna	4.3	7.5	4.3	7.5	2.3	8.0
Leachate of Annapurna	6.3	9.5	4.3	7.0	2.3	3.5
Leachate of Annapurna (aerated)	6.0	10.0	4.3	6.0	4.0	7.5

Annapurna only. Even in the other varieties the growth in length of the coleoptile and the seminal root is approximately 50% of the growth in pure water (Fig. 1).

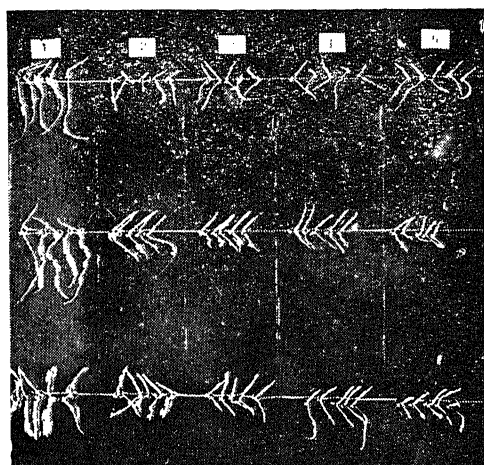


FIG. 1. Showing the effect of water leachates of ragi seeds (1. Water, 2. 1:1, 22, 3. Aruna, 4. Annapurna, 5. Annapurna (aerated)) on the germination of ragi (H. 22: top line, Aruna: Centre line, Annapurna: Bottom line).

Paper chromatography of the leachates was conducted to determine the R_f of the inhibitor. Five ml. each of the leachates from three different varieties were reduced to about 0.2 ml and developed in phenol: water (1:4 v/v) solvent system. After washing the paper with absolute ethyl alcohol, the paper was cut into 10 equal strips. Each strip was taken in a petri dish with 1 ml of water for germination test using 10 seeds. In all cases and in three different experiments the R_f of the inhibitor was in the range of 0.6 to 0.8 with a peak at 0.7.

The original leachate is brown in colour. It was decolorised by activated carbon. The coloured fraction was eluted from activated carbon with iso-propanol and water 1:1 (v/v). The eluate was evaporated to dryness at 60° C. and the residue was taken in water, maintaining the original concentration. The coloured and colourless fractions, along with the original leachate, were tested for germination using different concentrations. The results are presented in Table III. It can be seen that the decolorised

TABLE III

Effect of different concentrations of original leachate (O.L.), decolorised fraction (D.F.), and coloured fraction (C.F.), on (a) germination percentage, (b) length of seminal root, (c) length of coleoptile from variety Aruna on variety H₂₂

Dilution of leachate in 5 ml.	(a)			(b)			(c)		
	Water	O.L.	D.F.	C.F.	Water	O.L.	D.F.	C.F.	Water
00	93	..	..	..	52	..	..	..	25
0.10	..	98	86	90	..	40	43	34	..
0.25	..	96	80	92	..	46	41	31	..
0.50	..	90	80	92	..	54	55	41	..
1.00	..	86	72	97	..	39	43	27	..
2.50	..	86	44	96	..	37	41	23	..
5.00	..	68	48	96	..	5	49	12	..

fraction shows a marked effect on the germination percentage and with increasing concentration the percentage inhibition is also increased, while in the original leachate the inhibitory effect is less marked. The coloured fraction has little inhibitory effect on germination while on the other hand it shows a slight promotive effect. This perhaps explains the lesser inhibitory effect of the original leachate. In the growth of the coleoptile and the seminal root the coloured fraction shows inhibitory effect even when only 0.1 ml. of the fraction was used in 5 ml. and the dilution is 50 times the original concentration. This inhibitory effect is also seen in the original leachate. The decolorised fraction, however, appears to be free from the inhibitor of the coleoptile or seminal root.

1. Kidd, F. and West, C., *Ann. Appl. Biol.*, 1938 p. 112.
2. Chippindale, H. G., *Ibid.*, 1934, 21, 225.
3. Dawson, M. J., *Ind. Jour. Plant. Physiol.*, 1965, 8, 52.
4. Evanari, M., *Bot. Rev.*, 1949, 25, 153.
5. Went, F. W., *The Experimental Control of Plant Growth*, Ronald Press Co., New York, 1957, p. 251.
6. Stoker, J. R., *Can. Jour. Biochem.*, 1964, 42, 851.
7. Thimann, K. V. and Bonner, W. D., Jr., *Proc. Nat. Acad. Sci.*, 1949, 35, 272.

SUB-HAPLOID POLLEN IN *AMARANTHUS*MOHINDER PAL AND T. N. KHOSHOO
National Botanic Gardens, Lucknow, India

AS pointed out by Khoshoo¹ a study of pollen mitosis offers several advantages, one of the important being the study of chromosome balance and fertility in numerical hybrids. Some interesting features came to light during the course of such an investigation on a dibasic triploid *Amaranthus* hybrid ($2n=49$) reported earlier by Pal and Khoshoo.²

The hybrid arises spontaneously wherever *A. dubius* ($2n=64$, $x=16$) and *A. spinosus* ($2n=34$, $x=17$) grow in sufficient proximity. The parents have normal meiosis with 32 and 17 chromosomes (Figs. 1-2) respectively in pollen grains. Pollen of the amphiploid, *A. dubio-spinosus* ($2n=98$), contains 49 chromosomes (Fig. 3). In all these the pollen is shed at trinucleate stage.

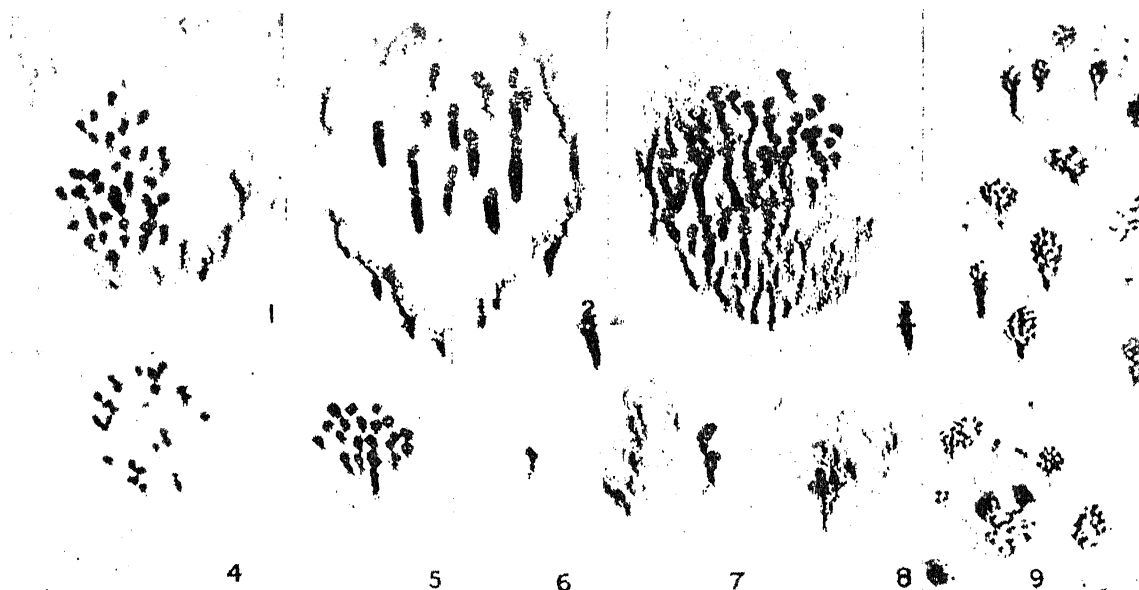
More than 50% pollen mother cells of the F_1 *A. dubius* \times *spinosus* ($2n=49$) contain 17 II + 15 I. The two extremes, however, are 19 II + 11 I and 16 II + 17 I. Pollen of the hybrid is of two types, macro- (21-26 μ , 77%) and micropollen (8-14 μ , 23%). Both occur regularly. Lagging univalents are the source of micropollen. Chromosome number in the former ranges from 19 to 27 (Figs. 4-5), while the latter contains only 1 to 4 chromosomes (Figs. 6-8). Among micropollen grains, those containing one chromosome are the most common (44%), followed by those with two (39%), four (11%) and three (6%) chromosomes. Although all such grains are much smaller than macropollen, yet the two appear to be alike in external character of exine. There is a general correlation between number of chromosomes and size of pollen, but increase or decrease by about four chromosomes is unable to affect the size.

A distinct difference between the rate of development in the two types of pollen (Fig. 10) has been noted. However, there is no difference at prophase, but the same is apparent at metaphase. Furthermore, micropollen does not proceed beyond this stage, but all macropollen becomes binucleate following an asynchronous development. Only 8% macropollen is trinucleate at anthesis. The balanced grains probably develop faster than the unbalanced ones. This asynchrony, found between and within micro- and macropollen, naturally has been created by qualitative and quantitative segregation at meiosis. Possibly there may also be associated differences in cytoplasm.

The total absence of anaphase and binucleate condition in micropollen is perhaps due to the absence of spindle formation. However, chromosomes become double (Figs. 6-7) indicating a normal cycle of DNA synthesis. Since the spindle is composed largely of protein and some RNA, it appears that quantity, particularly of the former, sufficient to organize a normal spindle is not synthesized during the resting stage. This point needs experimental verification. The net result is that directive influence of spindle on centromeres of otherwise double chromosomes is absent.

The strong developmental difference between the two types of pollen (Fig. 10) vanishes altogether when due to cold shock, walls either fail to develop or are feebly developed among the constituents of a tetrad ensuing from a single pollen mother cell (Fig. 9). In such cases there is synchrony not only between macro- and micropollen within a single tetrad, but also at intertetrad level. The former is perfectly understandable, because components of one pollen mother cell form a single balanced unit as long as they are held together, thereby enabling a free exchange of metabolites. The loss in one component compensates for the gain in another. Under such circumstances deficient nuclei can develop at the same rate as others. The intertetrad synchrony or developmental co-ordination within an anther sac appears also to be the result of feeble wall formation; maybe cytotoxic channels⁸ persist.

It is clear that in *Amaranthus* ($x=16$ and 17) pollen grains containing a single chromosome are deficient to the extent of 94%, and they are produced regularly in the F_1 hybrid. This is a unique situation because it is well known that pollen lacking just one chromosome in a basic complement ($x-1$), does not generally develop independently.⁴⁻⁷ However, two interesting cases have been reported previously. Johnsson⁹ made a passing reference about the occurrence of grains with one to seven chromosomes in a polyploid form of *Alopecurus* ($x=7$), but nothing more is known about it. Only two (out of 298) pollen grains with $n=3$, deficient to the extent of 50%, were observed in *Tradescantia* ($x=6$).⁴ Obviously in *Amaranthus* a single chromosome is reasonably balanced and, what is most important, survives independently for some time, enables external development of apparently normal exine,



FIGS. 1-9. Pollen mitoses. Fig. 1. *A. dubius* ($n=32$). Fig. 2. *A. spinosus* ($n=17$). Fig. 3. *A. dubio-spinosus* ($n=49$). Figs. 4-5. Macropollen in F_1 *A. dubius* \times *spinosus* ($n=25$ and 29). Figs. 6-8. Micropollen in F_1 ($n=1, 2$ and 3). Fig. 9. Intra- and inter-tetrad synchrony. Note different chromosome numbers in components of a single tetrad. Figs. 1-8, $\times 1,400$. Fig. 9, $\times 550$.

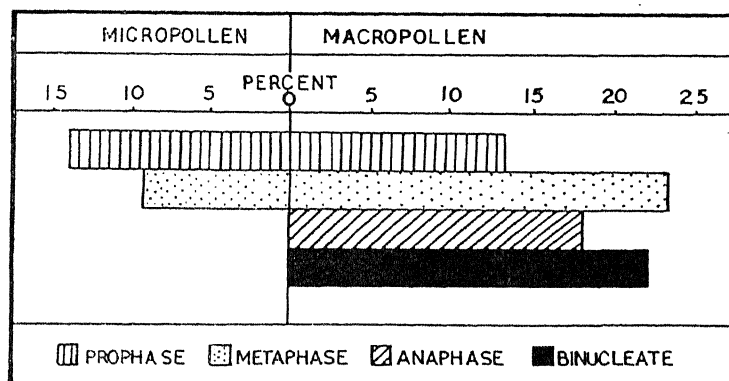


FIG 10. Histogram of the relative frequency and development of micro- and macropollen in the F_1 hybrid.

internally completes DNA synthesis, and finally proceeds up to metaphase. However, a cytogenetic study of the progeny of the F_1 hybrid reveals that micropollen is ineffective in fertilization.

Amaranthus offers a fine material in which cells with the lowest possible chromosome number ($n=1$) can exist up to a certain stage. If the life of such cells ($n=1, 2, 3, 4$) could be prolonged *in vitro* and induced to form a tissue, one would have an excellent experimental material for an intensive study of some of the fascinating problems in cell biology.

Our thanks are due to Dr. L. B. Singh,

Director NBG, for facilities and interest, to Dr. S. Ved Brat for discussion and to Mr. T. K. Sharma for photographs.

1. Khoshoo, T. N., *Proc. Indian Acad. Sci.*, 1966, **63 B**, 35.
2. Pal, M. and Khoshoo, T. N., *Curr. Sci.*, 1965, **34**, 370.
3. Barber, H. N., *J. Genet.*, 1942, **43**, 97.
4. Celarier, R. P., *Cytologia*, 1955, **20**, 69.
5. Conger, A. D., *J. Hered.*, 1940, **31**, 339.
6. Darlington, C. D. and Mather, K., *J. Genet.*, 1944, **46**, 52.
7. Wilson, J. Y., *Cytologia*, 1969, **23**, 435.
8. Heslop Harrison, J., *Ann. Bot.*, 1966, **30**, 221.
9. Johnsson H., *Hereditas*, 1944, **30**, 469.

LETTERS TO THE EDITOR

ELECTRONIC ABSORPTION SPECTRUM
OF 2-CHLORO-PARA-XYLENE VAPOUR

THE near ultra-violet absorption spectrum of 2-chloro-para-xylene has been photographed in the vapour state on a medium quartz spectrograph, at temperatures from 0°C to 100°C, using path lengths from 10 cm. to 100 cm. About 20 red-degraded bands have been obtained in the region 2800-2550 Å. With the strong band at ν 36279 cm.⁻¹ as the (0,0) band and with the help of the infra-red absorption of this molecule in the liquid state in the region 700-4000 cm.⁻¹ recorded and analysed by us (to be published), the bands have been interpreted in terms of two ground state and six excited state fundamental frequencies given in Table I, in which are presented for correlation the corresponding infra-red fundamentals obtained from our study of infra-red spectrum.

TABLE I
Fundamental frequencies in cm.⁻¹ of
2-chloro- para-xylene

Ultra-violet absorption spectrum		Infra red spectrum
Excited state	Ground state	
339	393	..
455	485	..
727	..	74?
1023	..	1054
1205	..	1221
1238	..	1290

It has not been possible to obtain any other bands on the long wavelength side of the (0,0) band, despite the fact that the spectrum was taken under rather widely different experimental conditions.

Department of Physics, M. A. SHASHIDHAR.
Karnatak University, K. SURYANARAYANA RAO.
Dharwar-3, September 22, 1966.

A NEW BAND SYSTEM OF SiBr IN THE
VISIBLE REGION

THE band spectrum emitted by a mixture of silicon tetrabromide vapour and argon as excited in a high frequency discharge of 40 Mc./s. from a 1/2 K.W. oscillator is photographed in the visible and ultra-violet regions employing Hilger two prism glass Littrow and Hilger quartz Littrow spectrographs. The photographs of the spectra revealed a new system of bands extending in the region 6600-4350 Å attributable

to the emitter SiBr molecule in addition to the bands belonging to the well-known two sub-systems of SiBr in the ultra-violet region 3300-2870 Å reported by Miescher¹ and Jevons and Bashford.²

The new system in the visible region consists of about 70 sharp bands which are degraded towards longer wavelengths. The vibrational analysis of these bands has led to the determination of the following vibrational formula:

$$\nu = 20937.7 + [250.3 (v' + \frac{1}{2}) - 0.53 (v' + \frac{1}{2})^2] - [424.5 (v'' + \frac{1}{2}) - 1.5 (v'' + \frac{1}{2})^2]$$

From the near equality of the vibrational constants, the lower state of this system may be identified as the lower state of one of the two ultra-violet sub-systems reported earlier.

The vibrational analysis is well supported by a study of bromine isotope effect for some of the bands of higher vibrational quanta.

Full details of the analysis will be published elsewhere.

Spectroscopy Laboratories, K. BABU RAO.
Physics Department, P. B. V. HARANATH.
Andhra University,
Waltair, September 30, 1966.

1. Miescher, E., *Helv. Phys. Acta.*, 1935, 8, 587.
2. Jevons, W., and Bashford, L. A., *Proc. Phys. Soc.*, 1937, 49, 554.

SPACE GROUP AND UNIT CELL
DIMENSIONS OF 2-PHENYL
BENZOXAZOLE

IN the course of X-ray investigations of some physiologically active compounds,¹⁻³ the authors have taken up the study of 2-phenyl benzoxazole (C₁₁H₉NO). This communication presents the crystallographic data on this compound.

The sample, used in the present investigation, has been synthesised by Subba Rao and Somayajulu.⁴ Analysis of rotation and zero layer Weissenberg photographs, taken with Cu K_α radiation showed that the crystal belongs to the orthorhombic system with

$$a = 14.62 \text{ Å}, b = 11.29 \text{ Å} \text{ and } c = 6.11 \text{ Å}.$$

The density of the crystal is determined by the flotation method using calcium chloride solution. The observed value 1.267 gm./c.c. is found to be in agreement with the value 1.286 gm./c.c., calculated for four molecules per unit cell.

An examination of the $hk0$, $0kl$, and hkl reflections on Weissenberg photographs showed the following systematic absences:—

hkl :	$k+1$	odd
$0kl$:	k	odd
	(l	odd)
$h0l$:	h	odd
	(l	odd)
$hk0$:	(k	odd)
$h00$:	(h	odd)
$0k0$:	(k	odd)
$00l$:	(l	odd)

This uniquely determines the space group of the crystal as $Aba2$. Further study on this crystal is in progress.

The authors wish to thank Dr. K. V. Krishna Rao for his interest and Dr. V. V. Somayajulu for providing them with the sample used in this investigation.

Physics Dept., P. VENKATESWARA RAO.
Osmania Univ., K. SATYANARAYANA MURTHY.
Hyderabad-7,
September 24, 1966.

1. Krishna Rao, K. V. and Venkateswara Rao, P., *Ind. Jour. Phys.*, 1963, 37, 546.
2. — and —, *Acta Cryst.*, 1965, 18, 572.
3. — and —, *Zeit. für Krist.*, 1965, 3, 122.
4. Subba Rao, N. V. and Somayajulu, V. V., *Proc. Ind. Acad. Sci.*, 1964, 59A, 396.

PRECIPITATION OF BERYLLIUM FROM HOMOGENEOUS SOLUTION IN PRESENCE OF PHTHALATE

BERYLLIUM can be precipitated in a dense and easily filterable form from homogeneous solutions in presence of sulphate¹ or succinate² by the urea hydrolysis technique. It has now been observed that beryllium can also be precipitated in dense and easily filterable form by precipitating it from homogeneous solution in presence of phthalate. A brief account of the results obtained is presented below.

To a solution containing not more than 45 mg. beryllium, are added 6 g. urea and 500 mg. potassium hydrogen phthalate and the volume is adjusted to 250 ml. with distilled water. The solution is then gently boiled on a hot plate for 1 hr. after the appearance of opalescence. The volume of the solution is kept constant during boiling by periodic addition of distilled water. The precipitate is allowed to settle and filtered through a Whatman-41 paper with a little paper pulp at the apex. The precipitate sticking to the walls of the beaker is removed with a rubber tipped glass rod. Finally the beaker is

refluxed with a few ml. of dilute hydrochloric acid and any beryllium thus recovered is precipitated with ammonia and filtered. The precipitate is washed with a 2% ammonium nitrate solution and the beryllium is estimated as oxide after igniting the precipitate in a platinum crucible at 1000° C. for 1½ hrs. The results are given in Table I.

TABLE I
Estimation of beryllium as oxide

B ₂ O taken (mg.)	pH of the filtrate	B ₂ O obtained (mg.)	Diff. (mg.)
25.8	7.5	25.8	0.0
25.8	7.4	25.6	-0.2
64.6	7.5	64.7	+0.1
64.6	7.6	64.6	0.0
90.5	7.6	90.6	+0.1
90.5	7.6	90.4	-0.1
120.0	7.5	119.8	-0.2
120.0	7.5	119.7	-0.3
129.2	7.5	128.6	-0.6
129.2	7.5	128.8	-0.4

As can be seen from the above results, beryllium can be satisfactorily estimated in the range 8–45 mg. beryllium.

The precipitation, under the conditions described above, starts at a pH 5.7 and is complete at pH 7.5. Ammonium salts give low results when present in the solution as the required pH cannot be obtained owing to the buffering action of phthalate in presence of ammonium salts.

The precipitate has been examined by the thermogravimetric, infrared and X-ray methods. The differential thermogram showed three distinct peaks at 160°, 260° and 550° C. The first peak is attributed to the loss of adsorbed water, the second peak to the decomposition of the beryllium hydroxide, and the third peak to the removal of phthalate from the precipitate. The infrared spectrum showed three peaks at 3500, 1020 and 1580 cm.⁻¹ The absorptions at 3500 cm.⁻¹ and 1580 cm.⁻¹ are due to the presence of water in the precipitate. The absorption at 1020 cm.⁻¹ may be attributed to the OH bending vibration of beryllium hydroxide.³

X-ray examination of the precipitate showed that the precipitate is amorphous.

One of us (T. P. P.) thanks the Council of Scientific and Industrial Research for financial assistance. Our thanks are due to Prof. M. R. A. Rao and Prof. A. R. V. Murty, Indian Institute of Science, Bangalore, for providing facilities for X-ray work and Prof. N. V. Subba Rao, Osmania University, for the infrared spectra,

Department of Chemistry,
Andhra University,
Waltair, August 1, 1966.

M. N. SASTRI.
T. P. PRASAD.

1. Sastri, M. N. and Prasad, T. P., *Talanta* 1966, **13**, 1517.
2. — and —, Unpublished studies.
3. Glemser, O., *Nature*, 1959, **183**, 1476, 943.

INFRA-RED ABSORPTION SPECTRA OF CO-ORDINATED NITRATO COMPLEXES OF COPPER (II) AND SILVER (I)

As part of our investigations on transition metal complexes, we reported earlier dinitrato copper (II)¹ and silver (I)² complexes with quinoline and isoquinoline. These complexes were shown to be non-electrolytes and hence nitrate was not expected to be present in the ionic state. The I.R. spectra could not be studied then and in this communication, we report I.R. absorption spectra which give direct evidence for the presence of co-ordinated nitrate in the compounds.

The complexes were mulled with Nujol and the spectra were recorded in the region 5000–650 cm.⁻¹ using a Unicam SP 200 double beam spectrophotometer with rock salt optics. The absorption bands obtained in addition to those pertaining to the ligand are recorded in Table I.

TABLE I

Infra-red absorption frequencies of dinitrato complexes of copper (II) and silver (I) (cm.⁻¹)

[CuQ ₂ (NO ₃) ₂]	[Cu(IQ) ₂ (NO ₃) ₂]	[AgQ ₂ NO ₃]	[Ag(IQ) ₂ NO ₃]
760 (w)	830 (w)	790 (sh) 840 (s)	780 (s) 850 (w) 860 (s) 900 (s)
978 (s)	985 (w)	1015 (s)	1055 (s)
1015 (s)	1030 (s)	1240 (s)	1190 (w)
1245 (w)	1290 (br)	1290 (sh)	1320 (br)
1295 (br)	1515 (w)	..	..

s=sharp; w=weak; sh=shoulder; br=broad;
Q=Quinoline; IQ=Isoquinoline.

The nitrate ion can co-ordinate to the metal either as a unidentate or as a bidentate ligand. Gatehouse, Livingstone and Nyholm³ have listed the infra-red absorption frequencies for ionic nitrate as well as for the co-ordinately bound nitrate group. It was also shown by Cotton *et al.*,⁴ that both uni- and bidentate nitrate groups give rise to bands in the regions 1531–1481, 1290–1253, 1034–970 and 800–781 cm.⁻¹ Band positions alone in the spectrum of co-ordinated nitrate groups are

insufficient to distinguish between the two different modes of co-ordination. Thus in the compound [Co(Ph₃PO)₂(NO₃)₂] which exhibits the characteristic frequencies in the I.R. region, it was thought that the metal ion was tetra co-ordinated.⁵ But a later structural determination⁶ showed that two oxygen atoms from each nitrate group were bound to the metal ion. Whilst it is not safe to conclude whether nitrate is functioning as a uni- or a bidentate ligand, it is possible to distinguish without any ambiguity a co-ordinated nitrate from an ionic nitrate. The results in Table I show clearly that these compounds absorb round about the region of a co-ordinated nitrate group and hence the nitrate is not present in the ionic state. This observation is in conformity with our earlier report that all these compounds are non-electrolytes.

We thank the Ministry of Education, Government of India, New Delhi, for the award of a Research Training Scholarship to one of us (R. N. P.).

Dept. of Chemistry, R. N. PATEL.
Regional Engg. College. D. V. RAMANA RAO.
Rourkela-8, May 18, 1966.

1. Patel, R. N. and Ramana Rao, D. V., *Ind. J. Chem.*, (In press).
2. — and —, *Curr. Sci.*, 1966, **35**, 408.
3. Gatehouse, B. M., Livingstone, S. E. and Nyholm, R. S., *J. Chem. Soc.*, 1957, p. 4222.
4. Cotton, F. A., Goodgame, D. M. L. and Soderberg, R. H., *Inorg. Chem.*, 1963, **2**, 1162.
5. Bannister, E. and Cotton, F. A., *J. Chem. Soc.*, 1960, p. 2276.
6. Cotton, F. A. and Soderberg, R. H., *J. Amer. Chem. Soc.*, 1963, **85**, 2402.

CHEMICAL EXAMINATION OF THE LEAVES OF RHODODENDRON VACCINOIDES HOOK.

PLANTS belonging to the genus *Rhododendron* are considered to be poisonous to cattle. *R. vaccinioides* has not been chemically examined so far. The leaves of this plant used in the present study were obtained from the Darjeeling Hills region in North-East India. The powdered dry leaves were extracted with petroleum ether, ether and alcohol in succession.

The petroleum ether extract on concentration yielded a crystalline mixture containing neutral and acidic substances. The crystallisate was dissolved in chloroform and shaken with aqueous sodium hydroxide and the mixture allowed to separate. The upper alkaline layer after separation and acidification yielded nothing worthwhile. The precipitate which floated at

the interphase between the two layers was found to be the sodium salt of ursolic acid (see below under ether extract). The chloroform layer contained a mixture of two substances (evidence from TLC on silica gel) which were separated by column chromatography on neutral alumina, whereby the pure components were obtained and were characterized as described below.

The petroleum ether eluate crystallised from chloroform-methanol as colourless needles, m.p. 201-02°, $[\alpha]_D + 73^\circ$ (chloroform); formula $C_{30}H_{50}O$. On treatment with hot alcoholic hydrogen chloride a new compound was obtained, $C_{30}H_{50}O$, m.p. 240-42°, $[\alpha]_D - 35^\circ$ (chloroform), which gave an acetate (pyridine-acetic anhydride at room temperature for 2 days), m.p. 287-88°, $[\alpha]_D - 18^\circ$ (chloroform). These reactions indicated that the parent compound might be campanulin.¹ The identity was confirmed by its colour reactions and by the observation that the m.p.s of these three substances were not depressed on admixture with campanulin, campanulol and campulol acetate respectively.¹

The benzene eluate of the above-mentioned chromatogram crystallised from chloroform-methanol as colourless needles, m.p. 258-60°, $[\alpha]_D - 29^\circ$ (chloroform), formula $C_{30}H_{50}O$. It was ketonic in nature, formed a DNP derivative, m.p. 303-305°, and on reduction with sodium borohydride followed by chromatography on alumina gave two substances, one melting at 274-75°, $[\alpha]_D + 25^\circ$ (chloroform) and the other at 296-98°. These observations and the colour reactions of the parent compound indicated that it might be friedelin and that the reduction products could be epifriedelanol and friedelanol respectively. These points were confirmed by mixed m.p. and comparative TLC employing authentic friedelin, epi-friedelanol and friedelanol obtained from the leaves of *Rhododendron grande*.²

The ether extract of the leaves again consisted of a mixture of acidic and neutral substances. It was dissolved in alcohol, treated with aqueous sodium hydroxide and diluted with water. The precipitate that was formed consisted of a mixture of the sodium salt of an organic acid and neutral substances. It was filtered, dried and extracted with chloroform which took up the neutral components. Column chromatography of this over alumina yielded the same two substances as were obtained from the petroleum ether extract, namely campanulin and friedelin. The sodium salt (which remained after chloroform extraction) was decomposed

with hydrochloric acid in hot alcoholic medium. The liberated acid crystallised from absolute alcohol as short stout rods, $C_{30}H_{48}O_3$, m.p. 280-82°, $[\alpha] + 63^\circ$ (ethanol); acetate, rectangular rods, m.p. 290-93°. These were found to be identical with ursolic acid and its acetate (mixed m.p. and TLC).

The alcoholic extract of the leaves was concentrated and the concentrate extracted in succession with petroleum ether, benzene, ether, cold ethyl acetate and hot ethyl acetate. The first two solvents extracted little. The ether extract gave colour reactions for flavonoids. Paper chromatography using butanol-acetic acid-water, 4:1:5, lower phase as irrigating solvent showed the presence of five components with R_f values 0.11, 0.13, 0.26, 0.53 and 0.84. The low yields prevented closer study.

The residue from the cold ethyl acetate extract was subjected to repeated purification by taking up in dry ethyl acetate and precipitating with petroleum ether. The residue m.p. 178-85° (d), $[\alpha]_D = +11.8^\circ$ (ethanol) gave reactions for leucoanthocyanidins. It was soluble in water and alcohol, insoluble in benzene and chloroform, gave a green colour with alcoholic ferric chloride and a rose red colour on boiling with alcoholic HCl. The flavylum salt prepared in the usual manner was studied in 1% aqueous hydrochloric acid solution. It was rose-red in colour, had absorption maximum at 543 m μ which shifted to 562 m μ on the addition of aluminium chloride, and had R_f value 0.54 in paper chromatography, using butanol-acetic acid-water, 4:1:5, lower phase. These indicated that the flavylum salt may be cyanidin chloride and that the parent substance may be leucocyanidin. These were confirmed by the colour reactions performed on the flavylum salt and by the leuco compound forming a hexaacetate, m.p. 126-34°, $[\alpha]_D 0^\circ$, and a tetramethyl ether with diazomethane, m.p. 175-88°, $[\alpha]_D + 20^\circ$ (ethanol). The tetramethyl ether formed a diacetate, m.p. 128-40°, and on oxidation with permanganate yielded veratric acid among the acidic degradation products; the identity of veratric acid was proved by comparison with authentic sample in a paper chromatogram using butanol saturated with ammonia as the solvent and buffered bromophenol blue-methyl red as the spray reagent.

The hot ethyl acetate extract of the alcohol extract of the leaves was examined in the same way as the cold ethyl acetate extract and the same results were obtained, i.e., it also contained leucocyanidin.

To sum up, the leaves of *Rhododendron vaccinioides* contained the triterpenoids friedelin, campanulin and ursolic acid, a mixture of 5 flavonoids and leucocyanidin.

The authors are grateful to Prof. Seshadri, F.R.S., for his kind interest.

Dept. of Chemistry, S. RANGASWAMI.
University of Delhi, V. SUBRAMONI IYER.
Delhi-7, August 8, 1966.

1. Rangaswami, S. and Sambamurthy, K. *Proc. Ind. Acad. Sci.*, 1961, **44 A**, 132.
2. — and Vankateswarlu, P., *Ibid.*, 1965, **62 A**, 224.

APPLICATION OF SEMI-QUANTITATIVE THEORY OF RESONANCE IN ELECTROPHILIC SUBSTITUTION

As one of the applications of his semi-quantitative theory of resonance, Bartell¹ has calculated resonance energy of the intermediate states in electrophilic substitution leading to *para* and *meta* substitution in styrene by using the equation

$$RE = 4/3 \beta (Nd - \sum pij^2)$$

where RE is the resonance energy of the molecule, Nd is the number of double bonds in any individual resonating structure, pij are the bond orders (Pauling) which are known by inspection from array of relevant resonance forms and β is the resonance integral in M.O. theory, the thermochemical value of which is 18 Kcal. The value of RE obtained for the former is 1.5 β , i.e., 27 Kcal. and that for the latter is 1.186 β , i.e., 21.4 Kcal. Higher value of RE for the intermediate state leading to *para* substitution in styrene is thus in conformity with the conclusion that can be drawn on the basis of qualitative theory of resonance and which explained greater *para* directing tendency

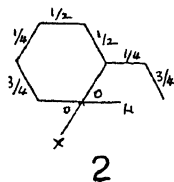
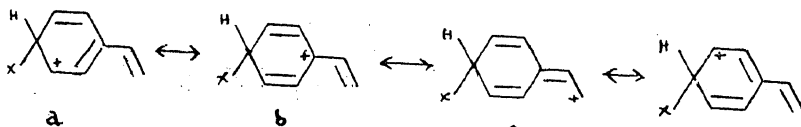
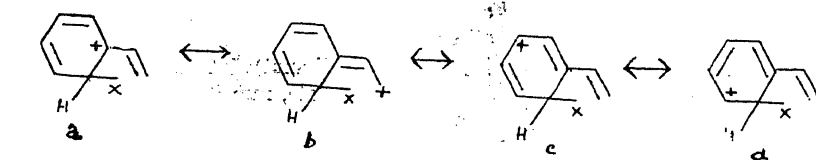
in styrene in comparison with its *meta* directing tendency.

Interesting result is obtained if the same equation is applied for finding RE of the intermediate state leading to *ortho* substitution in styrene as discussed below. Pauling bond orders calculated for the various bonds of this intermediate state on the basis of its conventional four resonating structures (Fig. 1) are given in Fig. 2.

Resonance energy (RE_0) of this intermediate state is then obtained by inserting the required values in the equation

$$\begin{aligned} RE_0 &= 4/3 \beta [3 - \{(3/4)^2 + (1/4)^2 + (1/2)^2 \\ &\quad + (1/2)^2 + (1/4)^2 + (3/4)^2\}] \\ &= 5/3 \beta \quad \text{substituting the thermochemical} \\ &\quad \text{value of } \beta = 18 \text{ Kcal.} \\ &= 30 \text{ Kcal.} \end{aligned}$$

Resonance energy of the intermediate state leading to *ortho* substitution in styrene, calculated in this manner, is thus higher by 3 Kcal. of energy than that of the intermediate state leading to *para* substitution (27 Kcal.), showing thereby that the former is more stabilised than the latter. This is not in conformity with the conclusion that can be reached on the basis of the presumption in standard text-books^{2 a, b} that *p*-quinoid structure is of lower energy content than the *o*-quinoid structure and the explanations advanced in such cases, according to which the latter intermediate state (Fig. 3) is more stabilised due to contribution from quasi *p*-quinoid structure (Fig. 3 c) in comparison with the former which has got contribution from quasi *o*-quinoid structure (Fig. 1 b). The validity of Bartell's equation may be questioned at this stage but at the same time it is to be noted that the presumption referred above is based on the relative stability of *o*- and *p*-



quinones as judged by the reduction potential of the two. Gould^{2a} has already pointed out that the reduction potential of a quinone in solution depends upon a number of factors other than the electron structure. In view of the contradictory results obtained by applying Bartell's equation, a rethinking on this point is essential. Application of Bartell's equation to other substituted benzene derivatives with substituents having +M, +E effects also leads to the conclusion contrary to the general notion² that the *para*-directing tendency is slightly more than the *ortho*-directing tendency in the electrophilic substitution of these compounds.

Org. Chem. Res. Labs., R. N. USGAONKAR.
Institute of Science,
Bombay-1, August 17, 1966.

1. Bartell, *Tetrahedron*, 1964, 20, 139.
- 2(a) Gould, *Mechanism and Structure in Organic Chemistry*, Holt, Rinehart and Winston, 1965, p. 439; see also footnote on page 439 under reference 46.
- (b) Peter Sykes, *Mechanism in Organic Chemistry*, Longmans, 1963, p. 114.
- (c) Packer and Vaughan, *A Modern Approach to Organic Chemistry*, Oxford, 1958, p. 581.

RECORD OF CONODONTS FROM INDIA *

WHILE working on the Palaeozoic and Mesozoic rocks of Kashmir Himalayas, the authors came across an interesting conodont fauna in the Lower Triassic limestone collected by B. S. Srivastava and H. M. Kapoor from Pastun,

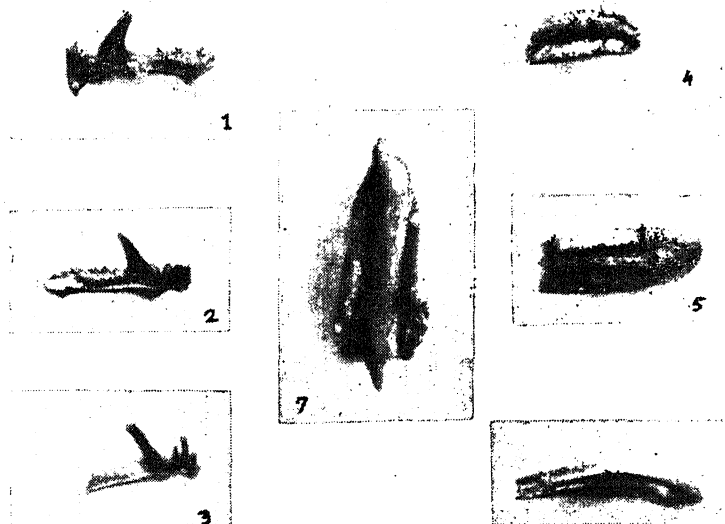
Anantnag District, Kashmir. Over 400 specimens have been recovered from a kilogram of the material.

The specimens were isolated from the rocks by the methods described by Collinson (1963) which were slightly modified to suit the laboratory conditions as follows:

Specimens of limestone weighing from 200 to 250 gm. were broken into small pieces, placed in beakers covered by 10% acetic acid for 24 hours with frequent shaking by a glass rod. The digested material which was retained on a 270-mesh sieve was dried and separated with tetra-bromothene ($C_2H_2Br_4$), the heavier particles taken out for examination.

Specimens of shales were broken and soaked in solvent oil (as Soddord's Solution was not available in the local market) for more than 24 hours. It was then treated with a detergent agent and boiled in water, the broken material was filtered as above and treated with tetra-bromothene.

The specimens recovered so far are mostly black although a number of brown and white forms have also been found. Since the black colour is sometimes confused with *Scolecodonts* although they are morphologically distinct, to remove all doubts regarding the nature of these specimens and their similarity with *scolecodonts*, a few specimens of different types (bar, blade and platform) were immersed in hydrochloric acid (concentrated) wherein they dissolved rapidly confirming their conodont identity.



FIGS. 1-7. Figs. 1-3. *Hindeodella triassica* Muller; lateral view of three different specimens. Figs. 4-6. *Gondolella* cf. *G. phosphoriensis* Y., H. & M.; upper (oral), lower (aboral) and lateral views of three different specimens. Fig 7. *Gondolella* sp. aff. *G. navadensis* Clark, 1959; upper (oral) view. (All figures are unretouched photographs, approx. $\times 33$.)

The fauna as a whole consists mainly of compound and platform type of conodonts, amongst which the latter predominate. Among the compound forms, there is a preponderance of blade-type forms. Their sizes vary from 0.4 to 4.00 mm. but most of them are less than a millimetre.

At present we are listing below only the forms which could readily be identified from the limited literature available to us.

1. *Hindeodella triassica* Muller, 1956 (Figs. 1-3).—Our specimens are similar to the holotype figured by Muller wherein the bar is nearly straight.

2. *Gondolella*.—This genus is represented by a number of forms in our collection among which the following provisional identifications have been made:

- (i) *Gondolella* cf. *phosphoriensis* Y., H. and M., 1951 (Figs. 4-6).
- (ii) *Gondolella* sp. aff. *G. nevadensis* Clark, 1959 (Fig. 7).
- (iii) *Gondolella* sp. aff. *G. denuda* Ellison, 1941.

3. *Parachirognathus* cf. *geiseri* Clark, 1959.—Specimens in present collection are very similar to those described by Clark but in our case denticles are smaller and fused for about half their distance.

The authors are grateful to Shri G. C. Chatterji, Director, Northern Region, Geological Survey of India, for his constant encouragement and guidance, to Dr. K. N. Kaul, Director, National Botanic Gardens, Lucknow, for facilities of photo-micrography and to Dr. R. C. Misra, Head of the Department of Geology, Lucknow University, for literature.

Geological Survey of India, J. P. SRIVASTAVA.
Northern Region, N. K. MANDWAL.
Lucknow, June 11, 1966.

* Published by the kind permission of the Director-General, Geological Survey of India, Calcutta.

1. Ash, S. R., "Bibliography and index of conodonts, 1949-1958," *Micropalaeontology*, 1961, 7, 213.
2. Clark, D. L., *Jour. of Palaeont.*, 1959, 33, 303 and 44.
3. Collinson, C., "Collection and preparation of conodonts through mass production techniques," *Illinois State Geol. Surv., Circular*, 1963, 343, 16.
4. Ellison, Jr., S. P., *Jour. of Palaeont.*, 1941, 15, 107, Pls. 20-23.
5. Muller, K. J., *Ibid.*, 1956, 30, 818, Pls. 95-96.

OCCURRENCE OF FOSSIL VERTEBRATES IN TIRUNELVELI DISTRICT

Fossil vertebrates occur in two localities: (1), at Ayanadapu—4 miles from Tuticorin on the Tuticorin-Palayamkottai trunk road and (2) at Pudukottai—8 miles from Tuticorin on the Tuticorin-Palayamkottai trunk road. This is the first reported occurrence of vertebrate fossils from these localities.

Tripathi¹ has earlier described vertebrate fossils including Proboscidiens from Sayamalai area, Tirunelveli District, Madras.

The present reported occurrences include many limb bones and a Proboscidian skull (Fig. 1). Associated with these vertebrate fossils there are numerous gastropod and bivalve shells in a fossilised state. The associated Invertebrate fossils indicate shallow marine conditions of deposition. Perhaps the area was an estuary where the transported vertebrate bones were deposited.



FIG 1

The Proboscidian skull collected is incomplete and includes well-grown molars, tusk sockets and palate. Frontal bones are not preserved.

The fossil fauna indicates a Pleistocene age. It appears that the deposits occur over an extensive area in the Tinnevely District. Further work on the vertebrate remains of this area would lead to a better understanding of the evolution and distribution of the Proboscidiens and other vertebrates during the Pleistocene period in India.

The author is grateful to Dr. N. Rajagopalan, Professor of Geology and Dr. P. Govindan, Professor of Zoology, for their help and encouragement.

Annamalai University,
Annamalainagar,
June 6, 1966.

D. C. V. EASTERSON.

1. Tripathi, C., *Rec. Geol. Surv. India*, 1964, 93, Part 2, 257.

ELECTRON MICROSCOPIC STUDY ON THE NORTHERN BLACK POLISHED (N.B.P.) WARE OF INDIA*

The Northern Black Polished Ware, popularly referred to as the N.B.P. Ware, is of considerable significance in the study of Indian Archaeology. According to Subbarao, it is the most crucial pottery type because the whole fabric of early historic chronology of the sub-continent is based on this Ware.¹

The Ware merits distinction in the study of Ancient Indian ceramic technology. It is wheel made and normally thin with a steel-like quality. It has a grey core and lustrous surface finish. The colour of this shining slip varies from the common coal black shade to steel blue, silvery, golden and pinkish; the last three being rare. According to Wheeler, this Ware is as distinctive in the sub-continent as is *Terra sigillata* in European sites.²

The Ware has been recovered from several excavation sites.³ These excavations indicate that the Ware was mainly manufactured in the plains of the river Ganga. It has a very wide distribution, from Somnath in the West to Bangara in the East and Taxila in the North to Amaravati in the South.

At Taxila it was excavated from pre-Alexandrian levels (6 to 13 feet deep). A hoard of coins with one of Alexander was found at 6 feet depth.⁴

At its chief type site, Kausambhi, it occurred in the layers preceding the one where were found coins of Mitra rulers of Kausambhi, assignable to the 2nd century B.C.⁵

At Hastinapur, it was recovered from levels below the lowest occurrence of Punch-Marked coins indicating that this Ware preceded the usage of Punch-Marked coins, which are dated at 600 B.C.⁶

So far there have been no radiocarbon dates for the early levels of the N.B.P. Ware. Two dates are available for its late levels from Hetimpur. At this site, the N.B.P. Ware levels are dated at 50 B.C. and 130 A.D.⁷ Thus, from the available data, it is possible to conclude that the Ware was in use from 600 B.C. to 200 A.D.

An analytical study of the lustrous coal black slip of the Ware indicated that the presence of magnetic oxide of iron is responsible for its black colour, and the formation of glass-like

soda-alumina-silicate is responsible for its lustre.⁸

An electron microscopic study of this slip has now confirmed the above analytical study. As is shown in the electron micrograph (Fig. 1), the

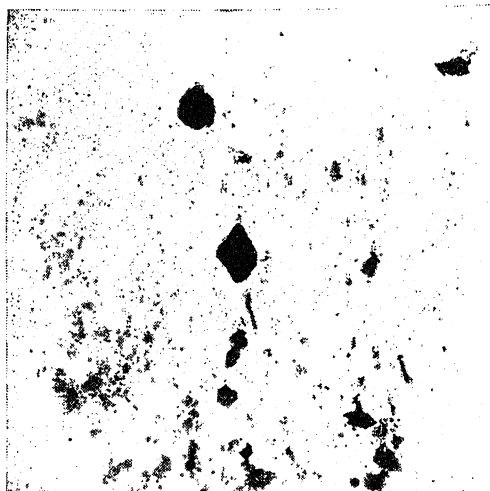


FIG. 1. Electron micrograph ($\times 10,000$) of the N.B.P. Ware slip. The specimen was studied using the indirect replica method. First a polystyrene replica was made. It was converted into a carbon replica. This was subjected to platinum-palladium shadowing to overcome contrast limitations.

shining coal black slip of the N.B.P. Ware consists of euhedral crystals of magnetic oxide of iron on a background of amorphous, structureless glass-like material. Magnetic oxide of iron, $\text{Fe}^{2+}\text{Fe}_2^{3+}\text{O}_4$ is opaque, isometric and black with metallic lustre in reflected light.

The author's grateful thanks are due to Professor T. L. Smiley for encouragement and Professor R. L. Sloane for helping in the electron microscopic study.

Department of Archæology K. T. M. HEGDE.
and Ancient History,
Faculty of Arts, M.S. University of Baroda,
September 17, 1966.

* This work was carried out while the author was a Fulbright Scholar at the Geochronology Laboratories of the University of Arizona, Tucson.

1. Subbarao, B., *Personality of India*, 1958, p. 45.
2. Wheeler, R. E. M., *Early India and Pakistan* 1959, p. 30.
3. Lal, B. B., *Ancient India*, 1955, 10-11, 143.
4. *Ibid.*, 1946, 1, 55.
5. *Op. cit.*, 1955, 10-11, 50.
6. *Ibid.*, 1955, 10 11, 50.
7. Agrawal, D. P. *et. al.*, "Tata Institute Radiocarbon Date List III," *Radiocarbon*, 1965, 7, 292.
8. Hegde, K. T. M., "Technical Studies in Northern Black Polished (N.B.P.) Ware," *Journal of the M.S. University of Baroda*, 1962, 11 (1), 159.

OCCURRENCE OF *NEREITES*, A FOSSIL POLYCHAET (ANNELIDA) IN RAJASTHAN

ANIMAL fossils of Jaisalmer area have been studied by Lubimova, Guha and Mohan¹; Sahni and Bhatnagar² and Subbotina, Datta and Srivastava³ in addition to the studies on fossils from different parts of Rajasthan by other workers. So far *Nereites* has not been recorded by these workers from Rajasthan. Here is reported for the first time the occurrence of this Polychaet worm from a location ca. 5 km. north of Jaisalmer, on way to Ramgarh.

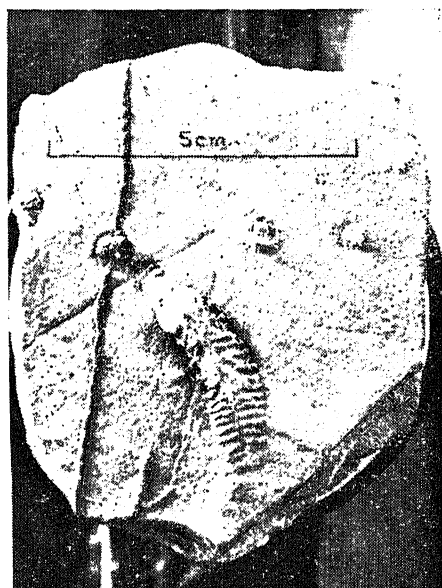


FIG. 1. Photograph of *Nereites*.



FIG. 2. Camera lucida diagram of head region (Magnified).

The scarp facing the road is constituted by pale yellow to yellowish-brown sandstone,

limestone and greyish-yellow to earthy shale and silt stone of Jaisalmer series of Upper Jurassic age.

The fossil (Fig. 1) is ca. 3 cm. in length, and is represented by the head and 16 segments of the body. The head region has four tentacles (Fig. 2, t). Along with the animal there are three (possibly four) roundish tubular structures seen in their cross-section. One of these structures appears to be a tube with the head of some worm protruding through it.

Jodhpur,
May 13, 1966.

P. D. GUPTA.*
M. L. SRIVASTAVA.**
V. C. AGRAWAL.*

* Desert Regional Station, Zoological Survey of India, Jodhpur.

** Exploratory Tubewell Organisation (Division III), Jodhpur.

1. Lubimova, P. S., Guha, D. K. and Madan Mohan, *Bull. Geol. Min. Met. Soc. India*, Calcutta, 1960, No. 22, 1.
2. Sahni, M. R. and Bhatnagar, N. C., *Rec. Geol. Surv. India*, 1958, 87 (2), 418.
3. Subbotina, N. N., Datta, A. K. and Srivastava, B. N., *Bull. Geol. Min. Met. Soc. India*, Calcutta, 1960, No. 23, 1.

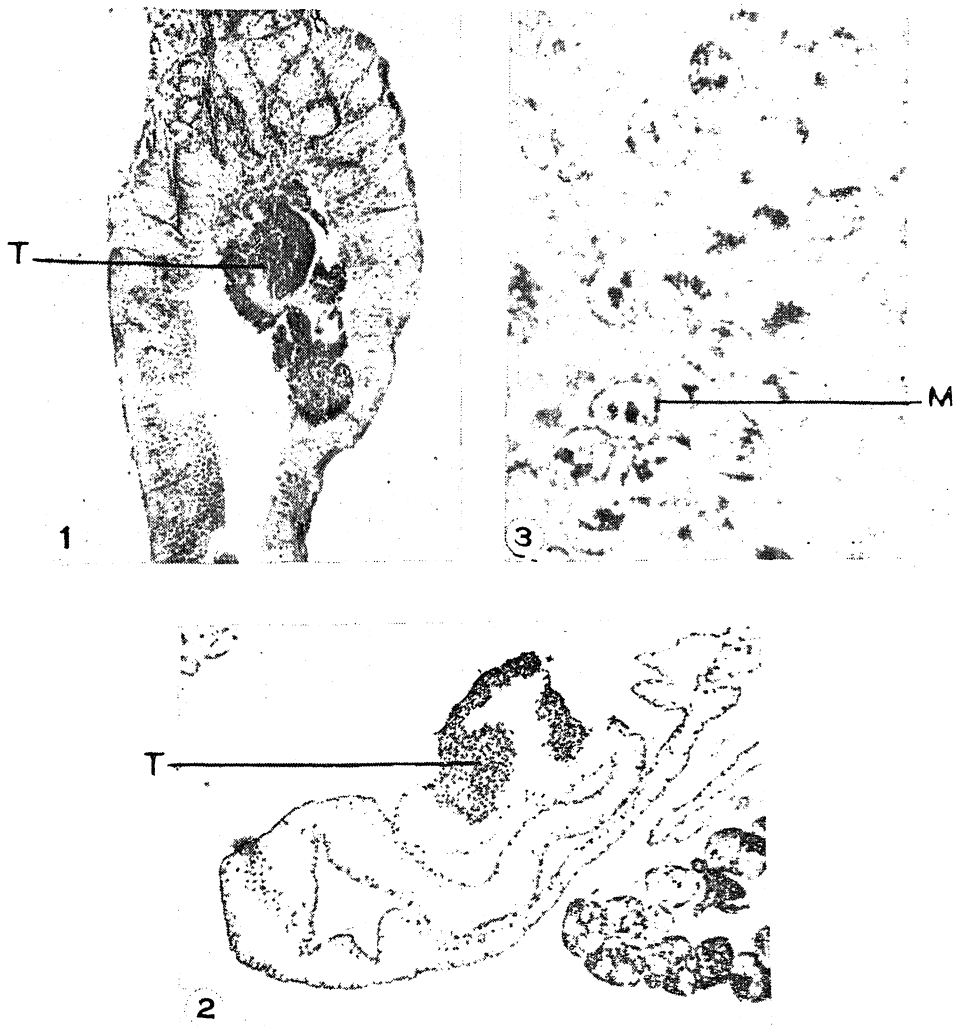
INDUCED GUT TUMOURS IN COCKROACHES

SEVERAL invertebrate groups have shown phenomena related to neoplastic growth¹ but details about their origin and relationships have been scanty. Insects have been observed to develop tumours as a response to various experimental interventions. Scharrer² discovered that the severance of the recurrent nerve in *Leucophaea maderæ* induces growth of tumour in the gut; later Matz³ has recorded in *Locusta migratoria* that injection of blood or crushed, cell-free filtrate of locust tumours exercises a carcinogenic effect.

Sectioning of the recurrent nerve has been found to induce tumour formation in the alimentary canal of the cockroaches *Periplaneta americana* and *Stylopyga* sp. It is observed that a rapid regenerative process sets in soon after nerve severance to restore the tract of the recurrent nerve. It has been found that neoplastic proliferations will develop, with even lethal effects, if regeneration and restoration of the nerve tract is prevented. The most common sites of tumour formation are the gastric caeca and the salivary receptacle (Figs. 1 and 2). The tumorous mass originates from the epithelium of the affected organ and pushes into the lumen. The regenerative cells or nidi, situated in the wall of the caeca, show an

increase in frequency of mitosis, and the migratory movement of the resultant cells towards the lumen indicates the origin of these tumours from the same. These cells are characterised by an increased size of their nuclei containing an abundance of sharply outlined, intensely staining, chromatin lumps. The nuclear enlargement and multiplication is not accompanied by a proportionate increase of cytoplasm and the presence of multinucleate cells is not uncommon. The cells within the tumorous mass are seen to undergo endomitosis (Fig. 3) with a bridge of chromatin between the two groups of chromosomes perhaps due to a rather disorganized

separation of the chromosomes during anaphase. Most of the nuclei at the site of the tumour develop a hyperpycnotic condition. Sections of tumorous tissues, stained according to Feulgen, reveal a considerably higher DNA content in the nuclei and this increase varies even within the same tumour and corresponds to the increase in nuclear volume. The migrant cells become distinctly discernible by about four to five weeks after nerve transection, the tumour growing larger and filling the lumen by about twelve to fourteen weeks. In the salivary glands the condition is one of hyperplasia, the nuclei being highly basophilic whereas in the



FIGS. 1-3. Fig. 1. Gastric caecum of *Periplaneta americana* showing tumour inside the lumen, 119 days after operation. About $\times 100$. Fig. 2. Salivary receptacle of *Periplaneta americana* having a prominent tumorous growth on its wall projecting into the lumen, 75 days after operation. About $\times 100$. Fig. 3. Tumorous growth of Fig. 1 at higher magnification showing endomitosis with chromatin bridges between the two groups of chromosomes. About $\times 1,300$. (T—Tumour; M—Mitotic figure.)

salivary receptacle the tumorous proliferation is observed to be well defined.

In *Periplaneta* the two sexes show differences in the tendency to develop tumorous growth, the females being more easily and seriously affected than males. Another striking feature is that the restoration of the recurrent nerve tract seems to bring about a regressive effect on the tumorous growth. It is interesting to recall here that the recurrent nerve which originates from the frontal ganglion is a pathway for the neurosecretory materials in insects.⁴ Studies are being continued to follow up the endocrine imbalances that set in as a result of the severance of this tract and also to assess the influence of the juvenile hormone from the corpora allata on the regenerative and oncogenic processes.

The author is grateful to Prof. K. K. Nayar for guidance and to the University of Kerala, for the award of the Government of India Research Scholarship.

Department of Zoology,
University of Kerala,
Trivandrum-7, June 8, 1966.

P. HEMA.

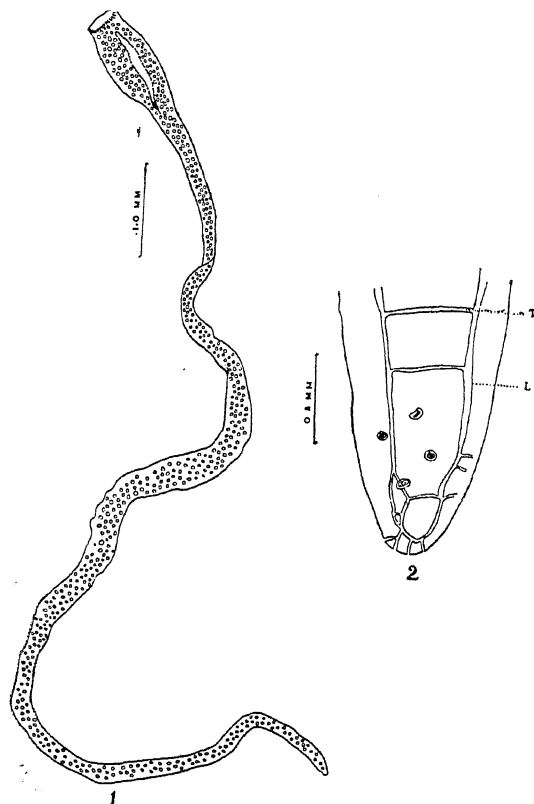
1. Scharrer, B. and Lochhead, M. S., *Cancer Research*, 1950, 10, 407.
2. —, *Proc. Soc. Exp. Biol. Med.*, 1945, 60, 184.
3. Matz, G., *J. Int. Physiol.*, 1964, 10, 141.
4. Nayar, K. K., *Zeits Zeilf.*, 1956, 44, 697.

**PLEROCERCROID OF *SENGA* SP.
(PSEUDOPHYLLIDEA: PTYCHOBOTH-
RIIDAE) FROM THE FRESHWATER
FISH *PANCHAX PANCHAX*
(HAM. AND BUCH.)**

The order Pseudophyllidea is a group of cestodes inhabiting freshwater and marine teleostean fishes as well as various amniotes including man. Although much information on adults of genera like *Bothriocephalus*, *Onco-discus*, *Ptychobothrium*, *Senga*, *Eubothrium*, *Penetrocephalus* and several others is available, data on life-cycles of many of the species included in these genera are extremely meagre. Nothing is known of the life-cycle of *Senga* species of which occur in the intestine of freshwater fishes. In a study on the parasites of fishes of a lake at Kondakarla (Visakhapatnam District) it was discovered that the fish, *Panchax panchax* (Ham. and Buch.) harbours in its body cavity encysted plerocercoids which appear to belong to the genus *Senga*.

The cysts are oval measuring 1.136 mm. in length. Three to four cysts may be present in each infected fish. The cyst wall is thin and

delicate and the larva could be seen actively moving inside. Slight pressure is enough to bring about rupture of the cyst wall. The plerocercoids (Fig. 1) measure 3.44 to 11.00 mm. in length. The scolex is 0.4–0.96 mm. in length and 0.304–0.4 mm. in breadth. Both the scolex and the body are loaded with calcareous bodies. The apical disc measures 0.24–0.32 mm. in diameter. It presents a dome-shaped appearance and bears the characteristic two rows of spines numbering 40–44. The spines measure 19.5 μ in length and are simple in structure. In each row 20–22 spines could be counted. These characters suggest that the present plerocercoid is referable to the genus *Senga*. The osmoregulatory system consists of two prominent lateral canals which are interconnected by transverse vessels. At the posterior end is present a network of these canals opening out by branches as shown in Fig. 2.



FIGS. 1–2. Fig. 1. Plerocercoid of *Senga* species. Fig. 2. Posterior end of osmoregulatory system, L—Longitudinal canal; T—Transverse canal.

Species of the genus *Senga* are reported from labyrinthiform and cypriniform fishes of South-East Asia.^{4,6,8} *S. besnardi* Dollfus, 1934¹ is from *Betta splendens*, the Siamese fighting fish.

S. ophiocephaliana Tseng, 1933⁵ occurs in *Ophiocephalus argus* at China and *Ophiocephalus striatus* at Bengal. *S. pycnomerus* (Woodland, 1924)⁷ is reported from *Ophiocephalus marulius* at Allahabad. Johri⁴ described *S. lucknowensis* from the spiny eel, *Mastacembellus armatus* Lacep. from Lucknow. More recently Fernando and Furtado^{2,3} described three more species *S. malayana*, *S. filiformis* and *S. parva* and furnished information on the diagnostic features of the species hitherto reported. It is not possible to make an accurate specific diagnosis of the plerocercoids in the absence of characters pertaining to the adult. The present discovery of the plerocercoid provides an important link in the life-cycle of *Senga*.

Our thanks are due to Prof. P. N. Ganapati for encouragement and facilities. One of us (P. R.) is grateful to the Andhra University for the award of a Fellowship.

Department of Zoology, P. RAMADEVI.
Andhra University, K. HANUMANTHA RAO.
Waltair, June 23, 1966.

1. Dollfus, R. P., *Bull. Soc. Zool. Fr.*, 1934, **59**, 476.
2. Fernando, C. H. and Furtado, J. I., *Bull. Nat. Mus. Singapore*, 1964, No. 32.
3. —, *Z. F. Parasitenkunde*, 1963, **23**, 141.
4. Johri, G. N., *Curr. Sci.*, 1956, **25**, 193.
5. Tseng, S. N., *J. Sci. Univ. Shantung*, 1933, **2**, 1.
6. Wardle, R. A. and McLeod, J. A., *Zoology of Tapeworms*, The University of Minnesota Press, 1952.
7. Woodland, W. N. F., *Parasitology*, 1924, **16**, 441.
8. Yamaguti, S., *Systema Helminthum*, Vol. II—*The Cestodes of Vertebrates*, Interscience Publishers, 1959.

A NEW SPECIES OF SPIDER OF THE GENUS SCYTODES (FAMILY SCYTODIDAE) FROM INDIA

SINCE Pocock's classical work (1900) on the Indian Arachnida no serious attention has been given to explore the spider fauna of this country. Even this representative work contains no references to such an obscure family as Scytodidae. No doubt the genus *Scytodes* has been mentioned twice before by Stoliczka (1869) and Tikader (1963). So far only two species of spiders of the genus *Scytodes* are known from our country, namely *Scytodes thoracica*, (Latreille) and *Scytodes propinqua*, Stoliczka. This new species is the third one of the genus from our fauna.

Scytodes mawphlongensis, Sp. Nov.

General.—Cephalothorax, legs and abdomen light yellowish-green. Total length 3.00 mm. Carapace 1.40 mm. long, 1.30 mm. wide; abdomen 1.60 mm. long, 1.20 mm. wide.

Cephalothorax.—Slightly longer than wide, very high posteriorly, clothed with fine hairs; provided with five blackish longitudinal lines, the middle line extending from the base of anterior median eyes to nearly the base of cephalothorax. Next two lines broad and conspicuous and the lateral most lines join posteriorly each other and form like "U". Eyes six and pale in colour, arranged in three widely separated pairs. Sternum nearly oval, clothed with hairs and provided with black dots. Labium fused to the sternum as in Fig. 1, c. Legs long, slender, clothed with hairs and small spines, patella and tip of tibia black, two longitudinal black lines on the ventral side of femora and one longitudinal black line on the dorsal side of tibia of I and II legs. Male similar with female, only smaller in size. Male palp simple as in Fig. 1, d.

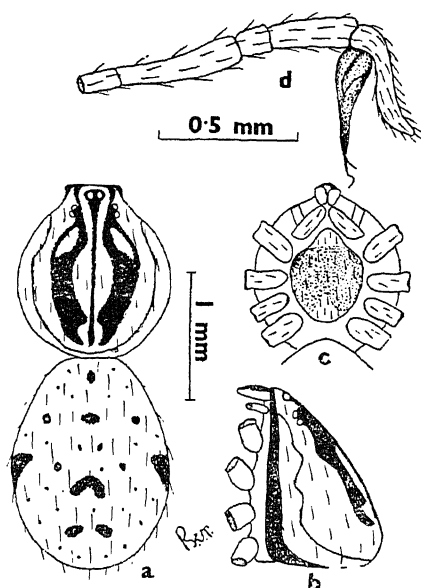


FIG. 1. *Scytodes mawphlongensis* sp. nov. (a) Dorsal view of female, legs omitted. (b) Lateral view of cephalothorax of female, legs omitted. (c) Ventral view of cephalothorax of female, legs omitted. (d) Right male palp.

Abdomen.—Nearly globular, covered with fine hairs, dorsally provided with small black patches and dots. Ventral side also provided with minute black dots. Epigyne simple.

Holotype.—One female, paratype, five females, allotype, three males in spirit.

Type Locality.—Mawphlong ca. 20 kilometres West of Shillong, District K. and J. Hills, Assam, India. Coll. B. K. Tikader, 12-4-1966.

This species is near to *Scytodes propinqua* Stoliczka, with type of which it has been

compared but differs as follows: (i) Lateral two longitudinal lines of cephalothorax broad and conspicuous and occupy major portion of cephalothorax but in *S. propinqua* all longitudinal lines of cephalothorax thin and inconspicuous. (ii) Abdomen dorsally provided with small patches and black dots but in *S. propinqua* abdomen dorsally provided with four narrow transverse black bands. (iii) Two longitudinal black lines on the ventral side of femora and one longitudinal black line on the dorsal side of tibia of I and II legs but in *S. propinqua* two longitudinal black lines on the dorsal side of tibiae and metatarsi of all legs.

Zoological Survey of India, B. K. TIKADER.
Eastern Regional Station,
Shillong-4 (India), June 20, 1966.

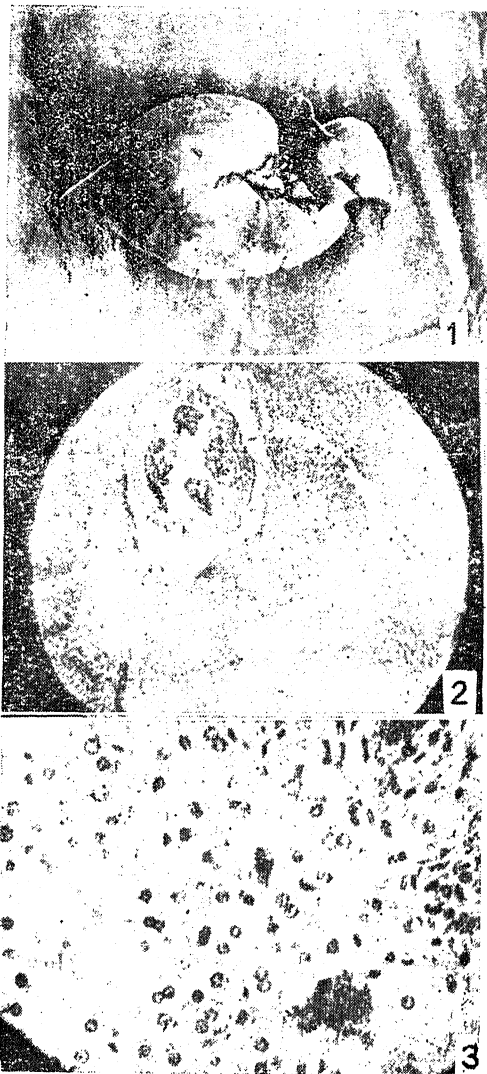
1. Pocock, R. I., *The Fauna of British India, Arachnida*, London, 1900.
2. Stoliczka, F., "Contribution towards the knowledge of Indian Arachnoidæ," *J. Asia Soc. Bengal*, 1869, 38, 201.
3. Tikader, B. K., "Studies on spider fauna of Maharashtra and Mysore States—Part I," *J. Univ. Poona Sci. and Tech.*, 1963, 24, 23.

TRANSPLANTATION OF *SETARIA DIGITATA* IN A RABBIT, ITS ERRATIC MIGRATION INTO THE LIVER AND A NOTE ON ITS HISTOPATHOLOGY

ERRATIC migration of *S. digitata* into the facial attachment of the right kidney, mesentery and a lobe of the liver¹ in the diaphragm, liver, omentum and urinary bladder² and *S. cervi* in the liver, diaphragm and heart³ was observed in cases of transplantation of these worms into the peritoneal cavity of rabbits. The detailed histopathological changes are described in this note.

Live specimens of *Setaria* sp. were collected from the peritoneal cavity of two bullocks. After specific identification, five males and ten gravid females of *S. digitata* were transplanted, within a couple of hours of collection, into the peritoneal cavity of a healthy rabbit on lines suggested by previous workers.^{1,3-5} The presence of any microfilariae was ruled out prior to transplantation by examining wet and stained blood smears for about 5 days continuously. The rabbit showed symptoms of paralysis of both hind limbs from the 5th day and died on the 8th day of operation. The microfilariae could not be detected in the blood smears during the lifetime of the rabbit. On postmortem examination only one live female

worm was found embedded in the liver parenchyma with its anterior end penetrating the liver (Fig. 1).



FIGS. 1-3. Fig. 1. Rabbit's liver showing *S. digitata*. Fig. 2. Liver parenchyma showing cross-section of the parasite and necrotic changes, $\times 50$. Fig. 3. Section showing retrogressive changes, $\times 450$.

Histopathological examinations revealed the cross-section of the parasite in the liver parenchyma and the changes mostly centred around the parasite. A small area of necrosis with disintegration and gradual disappearance of hepatic cells was noticed in the adjacent lobules. Marked leucocytic infiltration around necrosed lobules was seen. At several places there was evidence of extensive hæmorrhage and blood vessels away from the area of necrosis

were found to be fully engorged. The hepatic cells of the distant lobules revealed retrogressive changes characterised by cloudy swelling, fatty degeneration and condensation of chromatin material on the nuclear membrane, Karyorrhexis and/or Pyknosis. Increase in the amount of inter-lobular connective tissue particularly close to the location of the parasite was encountered. A slight proliferation of the bile duct with mild hyperplasia of the epithelium was also observed. Slight leucocytic infiltration around the bile duct in the portal area was also noticed. The portal area also showed a slight increase in connective tissue element (Figs. 2 and 3).

Although Lakra and Singh and Lakra, Singh and Shrivastava² reported erratic migration of *S. digitata* and Williams³ of *S. cervi* in the liver of rabbits, transplanted with these parasites, no account of histopathological changes of liver and route of migration were furnished. In the present study, it is reported that changes are limited round the parasite and the hepatic tissue are apparently healthy in the parasite-free areas. Therefore, it is presumed that the parasite entered the liver through parenchyma and the histopathological lesions noticed are due to the damage caused by the penetration of the parasite.

Authors express their gratitude to Dr. A. K. Varma, Director, for guidance and providing laboratory facilities and to Shri B. M. Prasad, for suggestions.

Livestock Research Station,
Patna,
May 10, 1966.

B. N. SAHAI.
S. P. SINGH.
H. B. SINHA.

1. Lakra, P., and Singh, S. P., *Indian Vet. J.*, 1963, 40 (4), 333.
2. —, — and Srivastava, V. K., *Ibid.*, 1964, 41 (3), 199.
3. Williams, H. E., *Parasit.*, 1955, 45 (1), 56.
4. Victor, D. A., *Indian Vet. J.*, 1958, 35 (5), 224.
5. Nelson, G. S., *J. Helminth.*, 1962, 36 (3), 181.

SPONTANEOUS AMPHIDIPOIDY IN F₁ PHASEOLUS AUREUS ROXB. × P. TRILOBUS AIT.

SPONTANEOUS origin of amphidiploid branch due to somatic doubling in the meristem of a lateral bud in F₁ hybrid has been reported in *Primula floribunda* × *P. verticillata* cross.¹ Naturally occurring fertile branches have been observed for the first time in three F₁ plants among a total of 123 F₁ plants raised from *Phaseolus aureus* Roxb. × *P. trilobus* Ait. cross. A fertile branch with many fruits is shown in Fig. 1. The adjoining normal branch did not produce

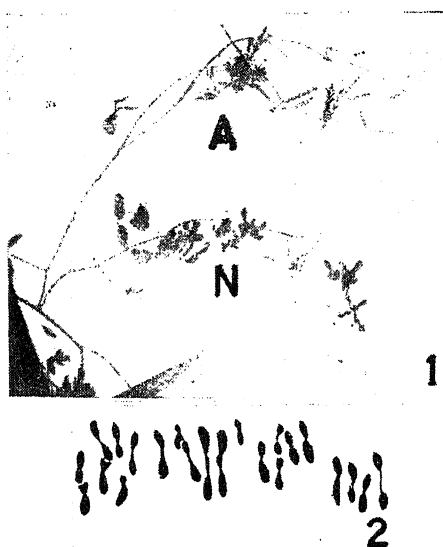
any fruit. The stomata and pollen characteristics of this normal branch and the spontaneously occurring fertile one were studied. The results are presented in Table I.

TABLE I
Comparison of normal and naturally occurring fertile branches

Characters	Normal	Fertile
*1. Size of stomatal guard cells (in μ)	7.5 × 4.6	8.5 × 7.5
*2. No. of stomata per sq. mm.	452.5	410.8
3. Pollen fertility (in %)	34	85
*4. Diameter of fertile pollen (in μ)	32	45

* Average of 10 observations.

These observations indicated the possible polyploid nature of the fertile branch, which was confirmed by the study of chromosome number at meiosis. Twenty-two bivalents were noted at metaphase-1 (Fig. 2). The normal F₁ plants had 2n = 22 chromosomes.²



FIGS. 1-2. Fig. 1. Naturally occurring fertile branch (A) and adjoining normal branch (N). Fig. 2. 22_n at MI. × 1,500.

The frequency of different types of chromosome association in F₁ was 0.16_{IV} + 0.005_{III} + 9.86_I + 1.6 per cell (averaged from 198 cells). Moreover, dicentric bridges with acentric fragment were observed in 15.1% cells at anaphase-1. Pachytene analysis has confirmed the presence of duplication, inversion and translocation heterozygosities in F₁.

Hence, it can be concluded that these fertile branches have originated through chromosome doubling in meristems of lateral buds in F₁ plants. This conclusion was supported by

another evidence. The plants raised from viable seeds produced in these fertile branches were identical in all respects to those raised from seeds obtained in colchicine-induced fertile branches in F_1 plants. The present observation points out that in *Phaseolus* the species with tetraploid chromosome number might have originated in nature through similar means from sterile interspecific hybrid. In the light of this view it is not surprising that the only tetraploid *Phaseolus* species reported so far is allopolyploid in nature.³ Chromosomal repatterning is an integral part of speciation in *Phaseolus*^{4,5} and hence it is likely that species crosses in this genus will result frequently in allopolyploid derivatives. Allopolyploidy is a significant evolutionary force in those genera where structural rearrangement of chromosomes is the principal mode of speciation.⁶

Department of Cytoogenetics and S. DANA.
Plant Breeding,
University of Kalyani,
Mohanpur, Nadia, West Bengal, India,
May 17, 1966.

1. Newton, W. C. F. and Pellew, C., *Jour. Genet.*, 1929, 20, 405.
2. Dana, S., *Cytologia* (In press).
3. —, *Nucleus*, 1964, 7, 1.
4. —, *Genetica* (In press).
5. —, *Nucleus*, 1966 9, 287.
6. Lewis, H., *Proc. 10th Internat. Bot. Congr.*, 1964, p. 134.

A NEW VARIETY OF

NITELLA TERRESTRIS (VAR. MINOR VAR. NOV.) FROM KERALA, S. INDIA

THE plant appears as grass green tufts, but slightly pale yellow at the time of reproduction. It is apt to be mistaken for moss growth, unless microscopically examined. It was collected at an interval of one week and live specimens had been worked out.

Plant 15–20 mm. high, bushy and much branched. Several primary branches grow obliquely upwards and serve for vegetative propagation by striking rhizoids at the nodes. Rhizoidal system highly developed, with branch-rhizoids in whorled clusters.

Length of an internode 1800–1850 μ ; breadth 130–140 μ ; branchlets 5–6 in a whorl; secondary rays 4–6; tertiary rays 2–4; dactyls 2-celled; ultimate cell normal, with a slight swelling at its base; tip conical, acute or slightly acuminate.

Monoecious; protandrous; no special fertile shoot; antheridia appear first, on any lateral of limited growth at the basal node, sometimes

terminal, replacing an ultimate lateral. There is usually an interval of one week between the first appearance of antheridia and oogonia. Later, antheridia and oogonia appear side by side, with the former above the latter (Fig. 1).

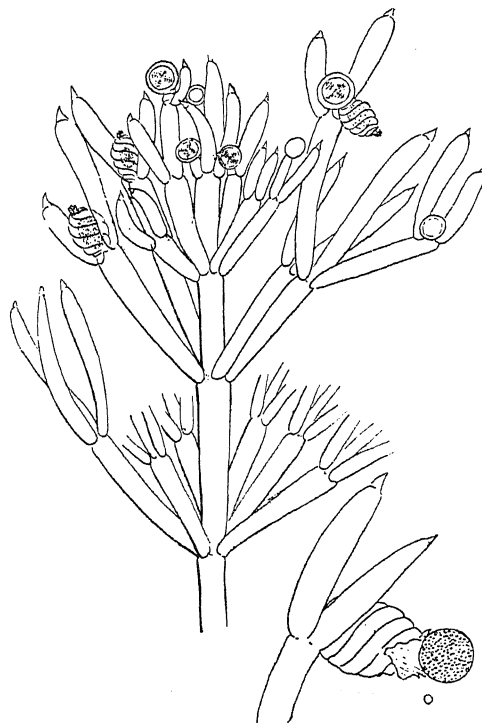


FIG. 1. *Nitella terrestris* var. *minor* var. nov.

Antheridia is quadrisculate, deep brown, 160–170 μ in diameter; oogonium yellowish-brown, 260–270 μ long, 190–200 μ broad; spiral cells show 7–8 convolutions; coronula small, 26 μ high, not persistent; ornamentation of the outer coloured membrane reticulate; spiral envelope is shed.

This species is smaller than the “extremely small” *Nitella terrestris* Iyengar, the only recorded terrestrial species recorded from Madras State.^{1,2}

Locality.—It grows in isolated patches, along the edges of the paddy field in Mulakulam, 40 kilometres away from Palai, Kottayam District, Kerala State. Fresh water. The area is liable to submersion due to flooding, once or twice during the season which extends not more than 2 or 3 days at a time. Otherwise the plant is full-time terrestrial. Collected in September 1965, towards the close of S.W. Monsoon.

Nitella terrestris var. *minor* var. nov.

Herba terrestris vel subaquatica, viridis sed sub-lutea ad reproductionem, 15–20 mm. alta,

ramosa ramis primariis non-nullis repentibus et radices prodeuntibus; spatia internodalium 1800-1850 μ longa, 130-140 μ lata. Ramuli 4-6 in verticillo; radii secundarii 4-6; tertiarii 2-4, dactylis bicellulatis; cellula ultima normalis sed paulum tumescens and basin, apice conico, acuto vel paulum acuminato. Reproductio monoica, absque surculo speciali fertili; antheridia apparent primo ut nodi terminales vel basales; tum et antheridia et oogonia apparent simul, antheridia supra oogonia. Antheridia quadrisutata, alte brunnea, 160-170 μ diam.; oogonium luteobrunneum, 260-270 μ longum, et 190-200 μ latum. Cellulae spirales monstrant spiras 7-8. Coronula parva, 26 μ alta, non-persistens; membrana exteriore oogonii reticulata; involucrum spirale dilabatur.

Lect. mense septembri anni 1965 ad Mulakkulam, 40 km. ex Palai in dist. Kottayam, in ditione Kerala.

St. Thomas College, P. M. CHACKO.
Palai, Arunapuram P.O.,
Kerala State, June 4, 1966.

1. Iyengar, M. O. P., "*Nitella ternstrois*," *Bull. Bot. Soc. Bengal*, 1958, 12, 85.
2. Pal, B. P., Kundu, B. C., Sundaralingam, V. S. and Venkataraman, G. S., *Charophyta*, Pub. I.C.A.R., New Delhi, 1961.

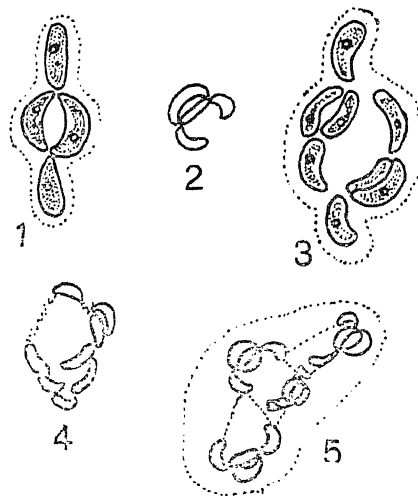
NOTE ON *TETRALLANTOS* *LAGRERHEIMII* TEILING

Tetrallantos lagerheimii Teiling was collected in the month of August 1964, from the ditches near Engineering College, Vallabh Vidyanagar, Gujarat State. It was found growing mixed with Desmids and some other members of Chlorococcales.

The plants are usually found in 4-celled coenobia surrounded by a mucilaginous sheath. Sometimes four or more colonies are embedded within a common mucilaginous matrix (Fig. 5). The cells are sausage-shaped, curved, with rounded apices (Figs. 1-5). In a coenobium, two cells placed centrally, form a pair and face each other by their concave faces, touching only at their poles. The other two cells which are in vertical plane, touch by one pole to the first pair, the second pole remaining free (Figs. 1-2). The cells are 4.5-7.5 μ in diameter and 13.0-17.0 μ long. Each cell has a parietal chloroplast with a pyrenoid.

The present plant agrees in general with the descriptions of *Tetrallantos lagerheimii* Teiling given by earlier workers.¹⁻³ However, the dimensions in this plant are more than those given by Forest³ and the cells are longer than those given by Prescott.² *Tetrallantos lagerheimii*

Teiling is considered to be a rare species.²⁻³ In the present area also, it is a rare plant, seen only once during the exploration of the area for over 12 years. As far as the author is aware, it is a new record for India.



FIGS. 1-5. *Tetrallantos lagerheimii* Teiling show the nature of the colonies and cell structures, $\times 520$.

Thanks are due to Dr. R. N. Singh for the facilities to work in the Department of Botany at Banaras Hindu University, Varanasi.

Department of Botany, R. J. PATEL.
Sardar Patel University,
Vallabh Vidyanagar,
Gujarat State, India, June 21, 1966.

1. Smith, G. M., *The Freshwater Algae of the United States*, 1950, p. 274.
2. Prescott, G. W., *Algae of the Western Great Lake Area*, 1951, p. 287.
3. Forest, H. S., *Handbook of Algae*, 1954, p. 143.

A SPONTANEOUS MACROMUTANT IN JUTE (*CORCHORUS OLITORIUS* L.)

A NEW type of mutant in jute (*Corchorus olitorius* L.), reported here, was collected from a fallow land in Science College, Ballygunge, Calcutta. The conspicuous characters of this mutant were deep green pigment, palmate type of leaf, notched cotyledon resulting in varied amount of polycotily, acute petal tip and cone-shaped pod with soft septum. A comparison between this mutant and a standard variety, JRO 632, regarding these characters, is presented in Table I. To ascertain the nature of inheritance, hybrids between mutant and standard varieties and test crosses were raised. Hybrids and segregating generations have shown that these phenotypes are inherited as a single unit.

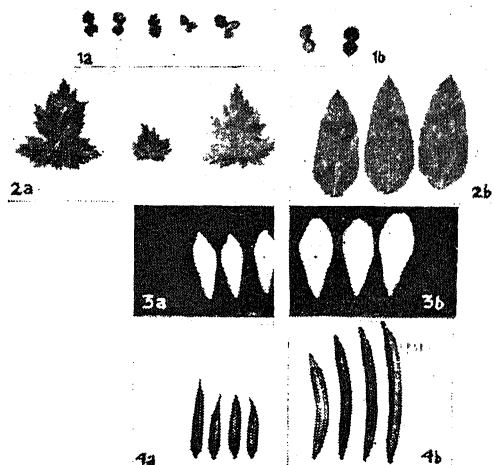
TABLE I
Showing comparisons between characters of the mutant and a standard variety

Characters		Mutant	JRO 632
1. Colour	..	Leaves are brilliant dark green	Leaves are less green
2. Cotyledon shape	..	Deeply notched or emerginate producing varied amount of polycotyly (Fig. 1 a)	Entire and absence of polycotyly (Fig. 1 b)
3. Leaf shape	..	Divergent palmate, sinuate, bisenated with overlapping bases (Fig. 2 a)	Oblong acuminate, serrated with non-overlapping bases (Fig. 2 b)
4. Leaf size :			
(a) Length	..	5.8 cm.	13.9 cm.
(b) Breadth	..	7.4 cm.	5.7 cm.
(c) Length to breadth ratio		0.78	2.45
5. Angle of variation from the base of leaf :			
(a) First angle	..	121.2°	70.3°
(b) Second angle	..	87.9°	39.7°
6. Number of veins per leaf		8.0	11.4
7. Flower	..	Conspicuous and small	Larger than mutant
8. Petal	..	Narrow and acute tip (Fig. 3 a)	Broader and obtuse tip (Fig. 3 b)
9. Pod	..	Cone in shape (Fig. 4 a). Non-shattering due to soft septa	Nearly barrel in shape (Fig. 4 b). Pod shattering due to hard septa
10. Fertility :			
(a) Pollen	..	88.5 %	96.0 %
(b) Female	..	Partially female sterile	Fully female fertile
11. Habit	..	Very slow in growth and bushy in appearance	Faster growing and non-bushy

In hybrids, these phenotypes are expressed as intermediate indicating that the mutant locus is incompletely recessive. This locus was found to affect several ontogenic cycles between cotyledon and pod formation and thus, alters a constellation of characters. For example, the palmate leaf shape is accompanied by the reversal of length to breadth ratio of leaf and greater divergence of veins and their numbers (*vide* Table I). It is obvious that in a palmate type of leaf the veins should be more divergent than those in a leaf of lanceolate or ovate shape. Furthermore, the functional norm of the chlorophyll apparatus in the mutant was altered. It was reflected in the occasional appearance of yellow mosaic spots in leaves of hybrid and segregating progenies. This mutant is bushy in appearance and slow in growth which may be secondary effect of the locus. It is, thus, evident that this locus controls several related morphogenetic processes. For instance, a palmate leaf is a result of differential apical and marginal meristematic activity in primordium to set the primary pattern which ultimately alters the vertical transverse component of leaf.⁵ The significance of genetical concept of Goldschmidt that genes affect the rate at which different processes of development proceed can be visualized in this mutant.

The above phenotypic and genetic evidences suggest clearly that the present mutant is a macromutant.⁴ In addition to this, few of the

characters, *e.g.*, palmate leaf and polycotyly, suggest it to be a systematic mutation. Because, the palmate type of leaf and polycotyly are hitherto unknown in the genus *Corchorus* and the former character is distinctly a primitive one.² This type of mutants occurring spontaneously in nature have also been reported by Kappert¹ in *Matthiola* and by Staudt³ in *Frageria*.



FIGS. 1-4

This mutant has proven to be genetically useful since it helps to know that the characters mentioned above and in Table I are under control of a pleiotropic gene. This was,

however, impossible to know from a homozygous standard phenotype.

The author is grateful to C.S.I.R., New Delhi, for awarding a Senior Research Fellowship and to Prof. P. N. Bhaduri and Mr. S. Dana for their interest in this study.

Department of Botany, S. L. BASAK.*
Presidency College,
Calcutta-12, May 30, 1966.

* Present address: Department of Cytogenetics and Plant Breeding, Faculty of Agriculture, University of Kalyani, Mohanpur P.O., Nadia District, West Bengal.

1. Kappert, H., *Ber. Deut. Botan. Ges.*, 1956, **68**, 413.
2. Ryder, V. L., *Bot. Rev.*, 1954, **20**, 253.
3. Staudt, G., *Naturwiss.*, 1959, **46**, 1.
4. Swaminathan, M. S., *Rad. Bot.*, 1965, **5**, 65.
5. Wardlaw, C. W., *Organisation and Evaluation in Plants*, 1965, p. 265.

REVIEWS AND NOTICES OF BOOKS

Linear Algebra. By Prof. Serge Lang. (Addison Wesley Publishing Company, Inc., 10-15, Chitty Street, London, W. 1), 1966. Pp. x + 294. Price \$ 7.00.

The present book is meant as a text for a one-year course in algebra at the undergraduate level, during the sophomore or junior year. It starts with the basic notion of vectors in real Euclidean space, which sets the pattern for much that follows. Examples and special cases are worked out in abundance, and abstractions are developed slowly.

Examples from calculus are given throughout, and in some sense, the book is a completion of the limited amount of algebra in the author's *A Second Course in Calculus*. A chapter treating the tensor product and the alternating product appears in the text. C. V. R.

Discharge Patterns of Single Fibres in the Cat's Auditory Nerve. By Nelson Yuan-Sheng Kiang. (The M.I.T. Press, Cambridge, Mass. 02142), 1965. Pp. xvii + 154. Price \$ 8.75.

This monograph represents a systematic attempt to describe in a quantitative manner the electrophysiological response in the peripheral auditory nervous system. A closely written report of important work, its publication has been eagerly awaited by other investigators in the field of hearing. The technical excellence of the experiments and the great amount of valuable data make this, indeed, a significant study. Virtually none of the data incorporating the use of modern computer techniques have been previously published.

The purpose of this research was to discover how the mammalian auditory nerve describes

sounds by examining the patterns of discharges in single fibres of the auditory nerve in response to controlled acoustic stimuli. The research itself was conducted on healthy adult cats but should have important bearing on the study of human hearing.

The titles of the chapters contained in this monograph are as follows: 1. Introduction; 2. Methods; 3. Spatial Organization of the Auditory Nerve; 4. Response Patterns to "Standard" Clicks; 5. Response Patterns in Relation to Changes in Click Level, Polarity, Duration, and Rate; 6. Response Patterns to Noise and Tonal Stimuli; 7. Tuning Curves; 8. Spontaneous Activity; 9. Responses to Combinations of "Simple" Acoustic Stimuli; 10. Discussion. C. V. R.

International Review of Cytology (Vol. 19). Edited by G. H. Bourne and J. F. Danielli. (Academic Press, New York and London), 1966. Pp. ix + 419. Price \$ 17.00.

The scope of this volume is indicated by the list of the chapters mentioned below: 1. "Metabolic" DNA: A Cytochemical Study, by H. Roels; 2. The Significance of the Sex Chromatin, by Murray L. Barr; 3. Some Functions of the Nucleus, by J. M. Mitchison; 4. Synaptic Morphology in the Normal and Degenerating Nervous System, by E. G. Gray and R. W. Guillery; 5. Neurosecretion, by W. Bargmann; 6. Some Aspects of Muscle Regeneration, by E. H. Betz, H. Firket, and M. Reznik; 7. The Gibberellins as Hormones, by P. W. Brian; 8. Photoaxis in Plants, by Wolfgang Haupt; 9. Phosphorus Metabolism in Plants, by K. S. Rowan. C. V. R.

Advances in Inorganic Chemistry and Radiochemistry (Vol. 8). Edited by H. J. Emeléus and A. G. Sharpe. (Academic Press, Inc., New York and London), 1966. Pp. viii + 365. Price \$14.50.

Volume 8 of this well-known series contains the following articles: Substitution Products of the Group VIB Metal Carbonyls, by Gerard R. Dobson, Ingo W. Stolz, and Raymond K. Sheline; Transition Metal Cyanides and Their Complexes, by B. M. Chadwick and A. G. Sharpe; Perchloric Acid, by G. S. Pearson; Neutron Diffraction and Its Applications in Inorganic Chemistry, by G. E. Bacon; Nuclear Quadrupole Resonance and Its Application in Inorganic Chemistry, by Masaji Kubo and Daiyu Nakamura; The Chemistry of Complex Aluminohydrides, by E. C. Ashby. C. V. R.

Silicate Science (Vol. V): *Ceramics and Hydraulic Binders*, by Wilhelm Eitel. (Academic Press, New York and London), 1966. Pp. xiv + 618. Price \$24.00.

Section A of this volume discusses the role of solid state reactions in modern silicate science, and emphasizes, as a basis for such reactions, the developments in the theory of structural defects as influencing the mobility of atoms by diffusion in a crystalline medium. The application of radioactive tracer techniques in studying the kinetics of such reactions is considered.

Classical clay ceramic methods are included in Section B as well as the important recent crystallochemical problems and thermochemical aspects revealed in important recent research of F. W. Brindley, M. Nakahira, and H. E. Schwiete.

Section C describes the latest investigations of hydraulic binders on a silicate and aluminium base. The results of the Third and Fourth International Symposia on the Chemistry of Cement, including important contributions by Russian scientists, are also reflected in this section. C. V. R.

Theory of Spectrochemical Excitation. By P. W. J. M. Boumans. (Hilger and Watts, Ltd., 98, St. Pancras Way, London N.W.), 1966. Pp. 383. Price £ 5 net.

Spectrochemical analysis is a well-known technique and thanks to the different types of

precision Hilger and Watts spectrographs readily available, this technique has become an essential course in analytical chemistry in colleges and a practical tool in industry and research. But a successful use of the technique for high precision analysis demands a thorough understanding of the physics of the d.c. carbon arc which is the common light source employed.

In principle the technique lies in comparing relative intensities of spectral lines and deducing therefrom the amounts of the elements present in the sample. The method being essentially empirical involves identical excitation of the samples. The constancy of excitation of the d.c. carbon arc source is a prerequisite for successful analytical results. But there remains the fact that the excitation characteristics of the arc are profoundly affected by the composition of the sample itself.

The author who has done extensive as well as intensive research on the subject views all aspects of spectrochemical excitation by d.c. carbon arc from a theoretical standpoint, and has produced a scholarly treatise on the subject. What the reader will find here is a thorough exposition of the laws that govern the excitation of samples, a knowledge of which will enable the spectrochemical analyst to proceed in a rational manner in the application of this technique. A. S. G.

Books Received

Application of Fracture Toughness Parameters to Structural Metals. By H. D. Greenberg. (Gordon and Breach, Science Publishers, 150, Fifth Avenue, New York, N.Y.), 1966. Pp. x + 406. Price: Paper \$ 10.50; Cloth \$ 24.95.

Annual Review of Plant Physiology (Vol. 17). (Annual Reviews, Inc., 231, Grant Avenue, Palo Alto, Calif. 94306), 1966. Pp. viii + 525. Price \$ 9.00.

Illustrations to the Flora of Delhi. By J. K. Maheshwari. (C.S.I.R., New Delhi-12), 1966. Pp. xx + 282. Price Rs. 28-00.

Advances in Space Science and Technology (Vol. 8). Edited by F. I. Ordway (III). (Academic Press, 111, Fifth Avenue, New York 10003), 1966. Pp. xiv + 395. Price \$ 16.00.

Fruits and Vegetables in West Africa. By H. D. Tindall. (Food and Agricultural Organisation of the United Nations via delle Terme di Caracalla, Rome), 1965. Pp. ix + 259. Price \$ 2.50 or 12 sh. 6d.